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HUMAN SYSTEMS INTEGRATION OFFICE

HUMAN SYSTEMS INTEGRATION REQUIREMENTS POCKET GUIDE

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14. ABSTRACT
This Human Systems Integration (HSI) Requirements Pocket Guide assumes a basic understanding of how requirements are written and placed into Joint Capabilities Integration and Development System (JCIDS) documents. This guide’s purpose is three-fold: First, to assist requirements writers in documenting solid, unambiguous human requirements in Air Force and DoD-level acquisition documents; Second, to assist HSI requirements writers in understanding where they fit into the Integrated Defense Acquisition, Technology, and Logistics Life Cycle Management System; Finally, to serve as a learning tool/quick reference source for HSI domain representatives who are called upon to assist with writing requirements documents. Included in this guide are DOs and DON’Ts of good requirements writing, sample requirements from approved programs, commonly misunderstood requirements terms and suggestions for better use, guidance documents for further reference, and contact information for commands and their areas of expertise.

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OVERVIEW

This Human Systems Integration (HSI) Requirements Pocket Guide assumes a basic understanding of how requirements are written and placed into Joint Capabilities Integration and Development System (JCIDS) documents. This guide's purpose is three-fold: First, to assist requirements writers in documenting solid, unambiguous human requirements in Air Force and DoD-level acquisition documents; Second, to assist HSI requirements writers in understanding where they fit into the Integrated Defense Acquisition, Technology, and Logistics Life Cycle Management System; Finally, to serve as a learning tool/quick reference source for HSI domain representatives who are called upon to assist with writing requirements documents.

Included in this guide are DOs and DON'Ts of good requirements writing, sample requirements from approved programs, commonly misunderstood requirements terms and suggestions for better use, guidance documents for further reference, and contact information for commands and their areas of expertise.

1. WHAT IS HSI?

Air Force Instruction 63-1201, Life Cycle Systems Engineering[a], defines Human Systems Integration as a disciplined, unified, and interactive systems engineering approach to integrate human considerations into system development, design, and life cycle management to improve total system performance and reduce costs of ownership.

The major categories or domains of Air Force HSI are:

- Manpower
- Personnel
- Training
- Environment
- Safety
- Occupational Health
- Human Factors Engineering
- Survivability
- Habitability

To ensure HSI is implemented throughout the system development life cycle, it is important that HSI efforts yield quantifiable and measurable impacts to system design. Three overarching "-ilities", and their associated supporting "-ilities" capture the breadth of HSI impacts on systems design. When writing requirements, the writer should consider the "-ilities" and ensure the requirement being developed includes human capabilities and limitations that can be linked to an "-ility" for verification in system evaluation activities. The primary "-ilities" are:

1. Usability – This means "cradle-to-grave" including operations, support, sustainment, training, and disposal. This includes survivability and habitability.

2. Operational Suitability – Includes utility, lethality, operability, interoperability, dependability, survivability, and habitability.

3. Sustainability – Includes supportability; serviceability; reliability, availability and maintainability (RAM); accessibility; dependability; interoperability; interchangeability; survivability and habitability.

(For complete definitions please refer to the Glossary)

2. WHY REQUIREMENTS ARE IMPORTANT

It is important to write requirements well. Systems are built to requirements, even when those requirements are insufficient, vague, or don't specify the needed operational capability. Requirements impact cost, schedule, and ultimately system design and performance. As stakeholders in the acquisition process, requirements writers have a unique opportunity to shape the final product.

Requirements in today's military are Capabilities Based. Requirements writers must focus on what needs to be accomplished (total system performance), rather than how to accomplish it. Good requirements will provide a clear picture of what the system needs to do and how well, not a blueprint. They should leave room for new technologies or approaches to be used in order to reduce or eliminate stove-piped, "we've always done it that way" problem solving loops.

Requirements begin by analyzing the differences between current and desired capabilities to identify Capability Gaps. Once these are known, they can be addressed through a variety of methods such as: purchasing more of a current item, modifying existing inventory, purchasing something that is commercially available, changing the way we organize or train, building something new, or investing in research and development. Most often, a combination of these solutions is needed and is most cost effective.

Requirements development is a collaborative process where stakeholders from the operational, maintenance, acquisition, test and evaluation, and other communities come together to provide the best, most thoroughly integrated solution possible. Throughout the process, stakeholders should remain focused on the Airman, seeking to maximize the capability provided to meet the identified need and accomplish the mission effectively. The role of Human Systems Integration is to ensure that the Airman is considered in the requirements development process.

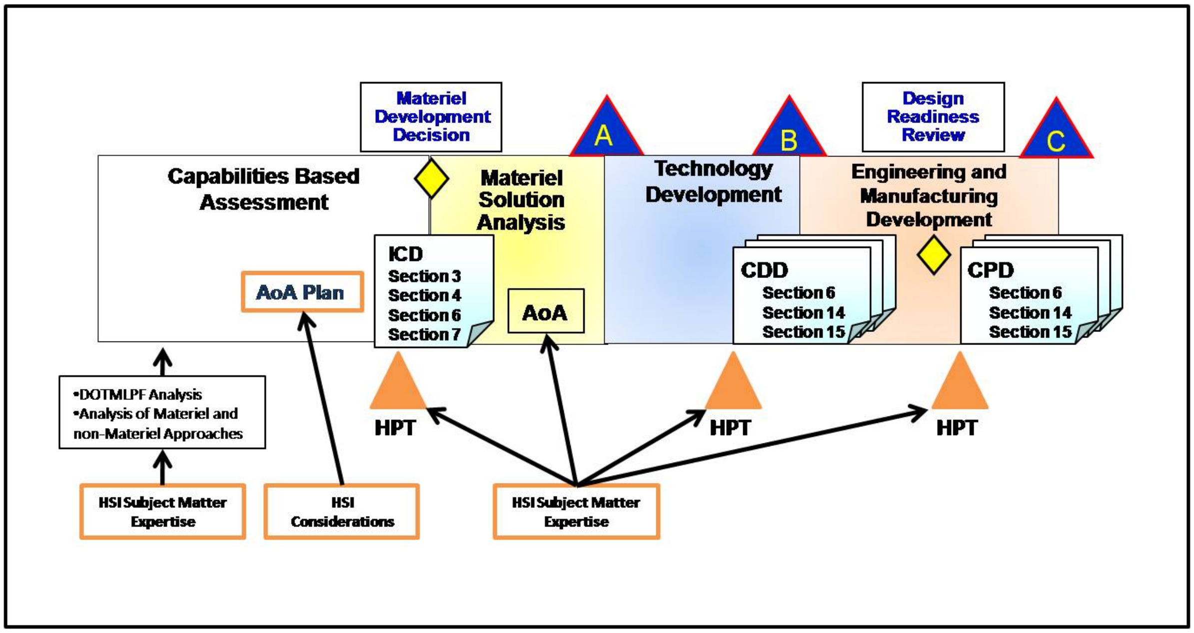
Where Does HSI Fit in These Processes?

HSI should begin prior to Materiel Solutions Analysis and requirements definition. Considering HSI early provides significant payoff for the Airman including improved training, increased system availability and reliability, easier and faster maintenance, and increased safety and survivability.

Figure 1 below identifies places in JCIDS where HSI strategies can be employed to provide significant positive impact on system development.

In the Capabilities Based Assessment (CBA), HSI expertise and analysis approaches must be used to support the required Doctrine, Organization, Training, Materiel, Leadership and education, Personnel and Facilities (DOTMLPF) analyses to capture impacts of non-materiel capability gap solutions on areas such as manpower, personnel and training. Additionally, during the CBA for materiel solutions, initial HSI considerations should be identified and included in the Analysis of Alternatives (AoA) Study Plan to ensure broad consideration of the human-related implications of the alternatives.

Figure 1 Human Systems Integration in Requirements



As a capability solution matures, HSI activities should focus on ensuring the HSI analysis activities conducted as part of the CBA are captured in the Initial Capabilities Document (ICD). The ICD summarizes the CBA and justifies the requirement for an approach to satisfy specific capability gap(s). This documentation includes the DOTMLPF implications and constraints of the proposed solution.

After Materiel Development Decision (MDD) approval, an AoA is required. In the AoA, HSI analysts should evaluate the alternative solutions to determine the alternative that maximizes Airman performance, minimizes HSI-related costs and supports safe and effective operations, maintenance, and support functions.

Along with participation in the AoA, the continued involvement of HSI analysts in the acquisition process includes participation in High Performance Teams (HPT) and Integrated Product Teams (IPT), ensuring HSI is integrated with the systems engineering process to derive capabilities based requirements for inclusion in the Capability Development Document (CDD) and Capability Production Document (CPD). HSI involvement in the systems acquisition development effort includes support to the generation of Requests For Information (RFIs) seeking to solicit industry input on potential design alternatives, evaluation of technologies proposed, and assessment of initial prototype devices.

It is important to remember that throughout the system acquisition life cycle the goal of the HSI practitioner is to integrate HSI considerations with JCIDS generated requirements. As such, HSI practitioners should avoid thinking in terms of “HSI requirements” which suggests that there should be unique requirements specific to HSI. Instead, the HSI community should focus on the fact that any requirement may have HSI implications and that the role of the HSI community is to highlight the human considerations that naturally occur as part of good and effective capability based requirements.

3. CONSIDERATIONS FOR HSI REQUIREMENTS [1]

A number of considerations should be evaluated to ensure human-related concerns are accounted for in the capabilities document. A few of the relevant concerns are provided for each domain in the following pages.

Manpower Analysis

Manpower Issues and Concerns
1. Is there a legacy system to use as a manpower baseline?
2. Do the manpower levels need to be constrained to the same level as the predecessor system?
3. Will the manpower mix (military, civilian, contractors) change significantly?
4. Is there a mandate to optimize or reduce manpower authorizations?
5. Have manpower authorizations been justified and/or modified to meet mission needs?
6. Will an increase in end-strength be required?
7. What are the end-strength offsets?
8. Approximately how many authorizations will it take to operate, maintain, train and support the full capability? (Full capability includes all operational and maintenance [local and remote] components.)
9. What manpower estimate was used for the affordability assessment?
10. How does the manpower estimate compare to current requirements and authorizations?
11. How much could manpower grow before it would impact the affordability decision?
12. If the manpower estimate is greater than authorizations, what is the resource sponsor’s position regarding funding?

[1] From the Human Systems Integration Development Guide: Capability Based Requirements, published by the 711th HPW/HPO, Brooks City-Base, TX (updated July 2009).

Personnel Analysis

Personnel Issues and Concerns
1. Are there any current or projected recruiting, retention, and/or career development issues for the personnel who are most likely to be required to operate, maintain, and support the capability?
2. Are there any current or projected pay/bonus/incentives required for the personnel communities who are most likely to be required to man the capability? Does this affect cost estimates and affordability assessments?
3. Are there any career path implications based on manning concepts being considered?
4. Are there any implications for rotation, deployed time, turnover/detailing based on the manning strategy discussed?
5. Will significantly new skill sets, knowledge bases, and abilities be required to support the capability?
6. Is there a need for increased experience or pay grades?
7. Is there a desire and/or need for unique combinations of skill sets, knowledge bases, and abilities?
8. Are the skill sets, knowledge base, and abilities required by the new capability projected to be available in sufficient numbers in the timeframe required?
9. Are there any known or projected changes to gender mix and/or cognitive abilities, physical characteristics, psychomotor skills, and/or experience level?
10. Does the materiel solution take into account the projected personnel pool?
11. Does the materiel solution require a change in the Air Force Specialty Code (AFSC) structure? See AFI 36-2101 at http://www.e-publishing.af.mil/b
12. Are new AFSCs required? Can the AFSCs be combined?
13. Are current accession screening methods (i.e., ASVAB) sufficient to ensure the new capability can be operated, maintained, and supported?

Training Analysis

Training Issues and Concerns
1. Was any part of the capability gap related to human performance or training deficiencies?
2. Could temporary or interim training be implemented to partially satisfy the capability gap, and/or improve mission performance with current systems until the proposed materiel solution can be developed and deployed?
3. Will deployment/employment of the new capability change tactics and decision-making?
4. Will changes in either individual or team training be required to address the change to tactics and/or decision–making?
5. Has the crew been tested for preliminary workload estimates in visual, auditory, motor, and cognitive capacity? Do they meet requirements?
6. If there is a desire and/or need for unique combinations of skill sets, knowledge bases, and abilities, are associated new training requirements feasible and reasonable (i.e., require new AFSC, changes to existing AFSCs)?
7. Will there be sufficient time to adjust and implement required changes to training?
8. Have total system operational performance, support, or life cycle cost objectives and thresholds been defined?
9. Will the materiel solution change who is to be trained (Active Duty, Air Force Reserve, Air National Guard, Civilian, Contractor)?
10. Will the materiel solution change who is to conduct the training (Government, Contractor)?
11. Will the materiel solution change where the training is conducted (Contractor Facilities, AF Technical Centers)?
12. Will the materiel solution impact the timing of the training (Duration, Availability)? Does this affect cost estimates and affordability assessments?
13. Will the materiel solution change the method of training used (Classroom, Computer-based, On-the-job)?

Human Factors Engineering Analysis

Human Factors Issues and Concerns
1. Does the materiel solution being discussed present any significant challenges, implications or constraints in the following areas: • Work/living space (especially number/size of berthing spaces) • System or display integration • Operability/Maintainability • Anthropometry/Ergonomics • Automation • Ambient environment
2. Does the materiel solution require a new system interface or modification to an existing interface?
3. Does the materiel solution require new forms of collaboration between humans and/or across systems?
4. Are there new lighting conditions? (Night, All Weather)
5. Is there special gear required that may impact task performance (Mission Oriented Protective Posture (MOPP) Gear, Cold Weather Gear)?
6. Are there manpower or personnel issues that may impact the system interface (Anthropometry)?
7. Will new technology impact the interface (Automation, Aiding)?
8. Does the materiel solution require the performance of additional tasks?
9. Are there specific performance thresholds and objectives that impact mission outcome?
10. Are there time limitations for task accomplishment?
11. Are there accuracy requirements for task accomplishment?

Environment Analysis

Environmental Issues and Concerns
1. What types of Hazardous Materials (HAZMAT) will be required for Operations and Maintenance? Can these be substituted and/or eliminated?
2. What are the anticipated air emissions from the system? Can they be reduced? What are the concerns for potential fielding locations? *Note – Areas that are in Environmental Protection Agency (EPA) non-attainment have more air emission constraints.*
3. What are the anticipated hazardous waste streams? Can they be recycled and/or eliminated?
4. What are the noise levels for the system? Can they be reduced? What are the concerns for potential fielding location? *Note – The primary concern is noise pollution and its impact on the surrounding communities.*
5. If HAZMAT and Waste cannot be eliminated then there will be additional training requirements for their use, handling, storage and disposal.
6. What are the system demilitarization and disposal requirements? Will this process generate waste with special handling/disposal requirements?
7. The system cannot use Class I and II ozone depleting substances.

Safety Analysis

Safety Issues and Concerns
1. Has a safety risk assessment been completed?
2. Have safety risks concerning power sources been considered? • Electrical • Mechanical • Hydraulics/Pneumatics • Chemical/explosive/propellants
3. Look for safety risks associated with: • Exposed, moving equipment • Radio Frequency (RF)/Microwave (MW) antenna • Hazardous materials or by-products • Combustion processes • High temperature devices • Vehicular movement/flight • Gun systems • Missile systems
4. Ensure design requirement statements have been developed to address/prevent the impact of: • Catastrophic loss of materiel system or Airman due to failure/malfunction of component or procedural error/omission • Operational loss of system or disabling injury due to failure/malfunction of component or procedural error/omission • Loss of system effectiveness or injury due to failure/malfunction of component or procedural error/omission
5. Are all trade-offs or impact issues looked at for their effects on all other HSI domain as well as system cost and performance requirements (e.g., excessive training and personnel capability requirements to compensate for materiel system design weaknesses?
6. Are all functional, cost and performance data, as well as assumptions and other criteria, consistent with other analyses being performed on the system?
7. Is the system safe for the Airman/civilian to operate, maintain, repair, and support?

Occupational Health Analysis

Occupational Health Issues and Concerns
Acoustical Energy
1. Does this system meet the standards for steady state noise under the most severe operational and maintenance scenarios?
2. Does this system meet the standards for impulse noise under the most severe operational and maintenance scenarios?
3. Does this system meet the standards for blast overpressure under the most severe operational and maintenance scenarios?
Biological Substances
4. Does the system configuration preclude exposure to microorganisms, their toxins and enzymes?
Chemical Substances
5. Does this system produce or release any toxic substance during maintenance and operation?
6. Are personnel exposed to unacceptable levels of toxic vapors, gases, or fumes?
7. Are there any unacceptable levels of toxic gases in the crew compartment when the vehicle is operating and/or during weapons firing?
8. Will any materials used decompose or react under extreme heat (pyrolytic) or in the presence of another substance to produce toxic fumes, gases, or vapors?
9. Is the crew effectively/adequately protected against Nuclear, Biological, and Chemical (NBC) agents?
10. Has each chemical or toxic material used in or with the system been identified in the health hazard assessment report?
11. Does a hazard from exposure to________exist?
12. Are personnel adequately protected from fire extinguishing agents?
Oxygen Deficient Atmosphere
13. Is there any potential for an oxygen deficient atmosphere in occupied spaces or compartments?
14. Will occupied spaces contain Halon 1301 automatic fire extinguishing systems that comply with Office of the Surgeon General (OTSG) and National Fire Protection Association (NFPA) requirements?
Radiation Energy
15. Are there hazards or potential hazardous exposures from ionizing radiation sources during operation,

training, and maintenance?
16. Are there hazards or potential hazardous exposures from non-ionizing sources during operation, training, and maintenance?
17. Does the system contain any lasers detrimental to health?
18. Has the system been evaluated for potential radiation health hazards?
Physical Forces
19. Will this system produce any physical hazards?
20. Is adequate protection provided to preclude trauma to the eyes or body surface during system operation or from personal protective equipment?
21. Does the system meet vibration and shock requirements under all operational conditions?
22. Are there potential hazards from high pressure gases or fluids?
23. Do hazards from excessive dust in crew compartments exist?
Temperature Extremes
24. Is there any potential exposure to extreme heat or cold during operation or maintenance that will adversely affect personnel?
25. Does the system provide adequate heating, cooling, and ventilation under routine, severe, and emergency conditions?
26. Are there any hazards associated with cryogenics?
Miscellaneous
27. Have health problems identified with reference systems and components been addressed and abated in this system?
28. Are health hazards identified during Initial Operational Test and Evaluation (IOT&E) and Final Operational Test and Evaluation (FOT&E) being resolved?

Habitability Analysis

Habitability Issues and Concerns
1. Does the system exhibit unacceptable conditions that might affect human performance capabilities (i.e., vision, olfaction, taste, hearing, reaction time, motor skills, strength, and cognitive skills)?
2. What is the overall acceptability of the physical environment (i.e., noise, lighting, odor, temperature control, humidity, temperature, contaminants)?
3. Have personnel services (i.e., nutrition, water, sleep, exercise, medical care (preventive, diagnostic, treatment) been considered?
4. Were living conditions (i.e., personal hygiene, body waste management, crew quarters, mess, exercise area, recreation, trash, stowage, etc.) considered?

Survivability Analysis

Survivability Issues and Concerns
1. Will the proposed capability increase the number/type (especially civilians and/or contractors) of individuals placed in harm's way?
2. Does the materiel solution introduce a new threat?
3. Does the materiel solution change egress systems requirements (if applicable)?
4. Was any part of the capability gap related to a fratricide incident or failure of personnel to survive a mishap?
5. Does the Concept of Operations (CONOPS) for the proposed capability increase the likelihood of fratricide and/or need for improved personnel survivability features?
6. Does the materiel solution impact Identify Friend/Foe (IFF) equipment?
7. Is the related IFF or target identification system effective to ranges at least as long as the weapons range?
8. Is the system's signature (visible, electromagnetic, etc.) similar to potential threat vehicles?
9. Is the IFF system a non-cooperative target recognition system (i.e., if an enemy tries to target you to find your position, does the system refuse to cooperate so as not to give any information to the enemy)?
10. Does the self-location equipment provide sufficient resolution to reduce fratricide?
11. Is the system's ability to distinguish between friendly and enemy targets compatible with mission oriented protective posture level IV (MOPP IV) (NBC individual protective equipment) conditions?
Reduce Detectability

12. Does the materiel solution change detectability?
13. Is the system likely to be detected by unfriendly forces because of: Visible static signature? Thermal (infrared) signature? Radio-frequency signature?
14. Have any electro-optical or optical components on the system been hardened to reduce optical cross-sectional measurements that are the cause of wide-angle and at-range detection?
15. Will unfriendly forces' use of obscurants prevent the system from detecting approaching systems?
Reduce Probability of Attack
16. Does the materiel solution change the probability of attack?
17. Is the system able to deflect attack by the use of: Active ballistic interdiction to deflect or destroy incoming munitions? Electronic jamming or spoofing of munitions sensors?
18. Has the system microprocessor code been protected from the presence or insertion of malicious code?
19. Does the system present a unique or highly recognizable signature (visual, thermal, etc.)?
Reduce Damage
20. Does the materiel solution reduce damage?
21. Does the materiel solution require a change in attack and attack prevention measures?
22. Does the system adequately protect the crew from direct- and indirect-fire munitions through the specific damage mechanism of spall?
23. Does the system provide crew protection from secondary explosions of the on-board munitions if the system is attacked, by means of separation of ammunition storage in a compartment isolated from the crew?
24. Does the system provide adequate crew protection from directed-energy weapons such as lasers?
25. Does the system provide adequate warning and protection for the crew in a nuclear, chemically or biologically contaminated environment?
26. Will the system be able to operate in the presence of external electromagnetic environmental effects without affecting crew members and other military personnel?
Minimize Injury
27. What are the potential sources for personnel injury in the system design and when the Airman and equipment are functioning in the field?
28. What is the system's ability to prevent further injury to the Airman after being attacked or exposed to a hostile environment?

29. What is the ability of the system to support treatment and evacuation of the injured?
Minimize Physical and Mental Fatigue
30. What are the physical constraints and workload placed on the Airman by the system?
31. What are the cognitive constraints and workload placed on the Airman by the system?
32. What is the system's ability to minimize the effect of environmental stressors on the Airman?
33. What is the system's ability to minimize the effect of mechanical (system-produced) stressors on the Airman?
34. What is the system's compatibility with crew life support and continuous operations?
Survive Extreme Environments
35. What are the extreme environments in which the Airman will use the system?
36. What is the system's ability to minimize the effect of arctic temperatures?
37. What is the system's ability to minimize the effect of high climatic temperatures?
38. What are the special considerations concerning extreme conditions to maintain an individual's life when operating in a sea or air environment until rescued or an improved situation on land is reached?

4. CRITICAL HSI NODES IN THE ICD AND CDD/CPD

As described above, HSI strategies can impact a capability development effort in its earliest stages. As HSI analyses are conducted and human-related requirements are developed, there are key places in requirements documents where these activities should be included to inform future design decisions.

Initial Capabilities Document (ICD) Table of Contents:

1. Concept of Operations Summary
2. Joint Capability Area
3. Required Capability
4. Capability Gaps and Overlaps or Redundancies
5. Threat and Operational Environment
6. Ideas for Non-Materiel Approaches (DOTMLPF Analysis)
7. Final Recommendations

The ICD captures results from the CBA and documents the requirement to resolve capability gaps. This information includes:

- A description of the capability gap(s) existing in joint warfighting functions
- A summary of the results of the DOTMLPF analysis and any nonmaterial changes possibly addressing the gaps identified
- Associated tasks, conditions and operational performance standards/metrics
- How the materiel and non-materiel approaches address the capability gaps identified

HSI implications from the CBA can be found in four sections of the ICD:

- Section 3- Required Capability: Documents the capability required. This is where the human-related implications identified in the CBA should be mentioned.
- Section 4- Capability Gaps and Overlaps or Redundancies: Describes the Capability Gaps: missions, tasks, and functions that cannot be performed or are unacceptably limited. The limitations of human performance should be included in this section.
- Section 6- Ideas for Non-Materiel Approaches (DOTMLPF Analysis):
  Details the results of the DOTMLPF analysis and provides a number of opportunities for HSI-related considerations to be introduced.
- Section 7- Final Recommendations: Describes materiel and non-materiel recommendations for responding to the capability gaps. HSI activities related to these approaches should be mentioned in this section.

By identifying the human touch points in the system emerging from the ICD, hooks are put in place where human-related requirements can be written into the CDD and CPD.

Capability Development Document (CDD) / Capability Production Document (CPD) Table of Contents:

Executive Summary

Revision History

Table of Contents

Points of Contact

1. Capability Discussion

2. Analysis Summary

3. Concept of Operations Summary

4. Threat Summary

5. Program Summary

6. System Capabilities Required for the Increment(s)

7. Family of System and System of System Synchronization

8. Information Technology and National Security Systems Supportability

9. Intelligence Supportability

10. Electromagnetic Environmental Effects (E3) and Spectrum Supportability

11. Technology Readiness Assessment

12. Assets Required to Achieve Initial Operational Capability (IOC)

13. Schedule and IOC/and Full Operational Capability (FOC) Definitions

14. Other DOTMLPF and Policy Considerations

15. Other System Attributes

16. Program Affordability

- Appendix A: Net-Ready Key Performance Parameter (NR-KPP) Products (aka Architectures)
- Appendix B: References
- Appendix C: Acronym List
- Appendix D: Analysis methodology and results (per J8 Manual: Appendix A, Enclosure G, page 2, paragraph 2)[c]

The CDD/CPD is written to define threshold and objective values for a single increment of the capability being developed. The primary objective of the CDD/CPD is to specify the operational performance criteria of the system being developed to deliver the required capability. The CDD/CPD considers and integrates the full range of joint materiel and DOTMLPF solutions. HSI should play a key role in the creation of the CDD/CPD in order to effectively translate user needs to system specifications. Specifically, there are three important sections of a CDD/CPD where HSI can have a direct influence on capability definition.

CDD/CPD Section 6: System Capabilities Required for the Increment

Section 6 provides a description of each system attribute and identifies the supporting rationale for the capability. Additionally, for Air Force documents, analytic references are cited to support the specific needs described in terms of threshold and objective values for the attribute.

Section 6 contains the required system performance attributes (not physical design attributes) that have implications for HSI. These attributes are prioritized as a Key Performance Parameter (KPP), a Key System Attribute (KSA), or an Additional Performance Attribute (APA). For each of the required and selectively applied KPPs and KSAs, a brief description is provided below.

Mandatory KPPs:

- Sustainment (aka Materiel Availability) KPP – The Sustainment KPP includes measures of both Materiel Availability (the percentage of the total inventory of a system ready for or performing tasking at a given time) and Operational Availability (the percentage of time that a system is capable of performing a mission).

  Mandatory KSAs associated with the Sustainment KPP include:

  - Materiel Reliability KSA: Materiel Reliability is a measure of the probability that the system will perform without failure over a specific interval and is generally expressed in terms of a Mean Time Between Failure (MTBF).
  - Ownership Cost KSA: Ownership Cost provides balance to the sustainment solution by ensuring the operations and support (O&S) costs associated with materiel readiness are considered in making decisions.

- Survivability KPP (manned platforms) – The Survivability KPP requires that, for manned systems, the design reduces the likelihood of the system being engaged by hostile fire.

- Force Protection KPP (manned platforms) – The Force Protection KPP deals with system attributes similar to those found in the Survivability KPP, but addresses the protection of personnel.

- Net-Ready KPP – This is generally a boilerplate paragraph; however the attributes of the system described under this KPP deal with the standards the system will use to make data visible, accessible and understandable to other systems on the Global Information Grid (GIG).

Selectively Applied KPPs:

- System Training KPP - The System Training KPP, when applied, is intended to ensure projected training requirements and associated costs are appropriately addressed across the program life cycle.

- Energy Efficiency KPP- The Energy Efficiency KPP, when applied, requires consideration for fuel efficiency for fleet purchases and operational plans consistent with mission accomplishment.

CDD/CPD Section 14: Other DOTMLPF and Policy Considerations
This section discusses any additional DOTMLPF and policy implications associated with fielding the system that have not already been addressed in the CDD/CPD, to include those approaches impacting CONOPS or plans within a combatant command's area of responsibility. In this section the CDD/CPD will highlight the status (strategy and timing) of the other DOTMLPF and/or policy considerations and describe the implications for likely changes to any aspect of DOTMLPF or policy.

In Section 14, the requirements writer should discuss HSI considerations that have a major impact on system effectiveness, suitability, and affordability.
For example, HSI would address considerations such as the key logistics criteria, including system reliability, maintainability, transportability, and supportability that will help minimize the system's logistics footprint, enhance mobility, and reduce the total ownership cost. Additionally, any basing needs (forward and main operating bases, institutional training base, and depot requirements), specific facility, shelter (habitability), supporting infrastructure and environmental, safety and occupational health (ESOH) asset requirements should be addressed.

CDD/CPD Section 15: Other System Attributes
Section 15 addresses attributes that tend to be design, cost, and risk drivers.
These attributes include ESOH, HSI considerations that have not been previously addressed, embedded instrumentation (human factors engineering), electronic attack (EA), information protection standards and information assurance (IA), and wartime reserve mode (WARM) requirements. In addition, HSI considerations including conventional and initial nuclear weapons effects; chemical, biological, radiological and nuclear (CBRN) survivability; natural environmental factors (such as climatic, terrain, and oceanographic factors, and impact of the systems on the environment); and unplanned stimuli (such as fast cook-off, slow cook-off, bullet impact, fragment impact, sympathetic detonation, and shape charge jet) are discussed in this section. Section 15 includes applicable safety parameters, such as those related to system, nuclear, explosive, and flight safety as well as physical and operational security needs (manpower, personnel and training).

Note: Section 15 discussions should not include Thresholds and Objectives, as these are not performance parameters, but rather "other system attributes." For Section 15, mention of the HSI-related concerns or implications associated with particular system attributes is usually a sufficient level of detail for the CDD/CPD. However, every effort should be made to ensure these considerations are costed appropriately into the program. Along with mention of these HSI items, the sponsor should be made aware that further detail on these issues will need to be provided in technical/acquisition documents.

5. HOW TO WRITE A GOOD REQUIREMENT

Section 6 of the CDD/CPD provides the HSI analyst the opportunity to influence future system design to include human-related considerations. In order to make the most out of this influence, and improve the likelihood for acceptance and proper implementation, HSI-related requirements should follow standard format and content conventions for effective requirements. This section of the guide details those conventions and provides guidance on writing effective requirements.

Along with appropriate content and format, a good requirement has eight characteristics. Requirements exhibiting these characteristics provide designers, builders and testers the information they need to translate the CDD/CPD into an actionable plan for obtaining the capability. The requirements writer should check to make sure the requirement is:

- Measurable: Quantifiable, repeatable, and verifiable
- Attainable: Feasible, affordable, and achievable
- Necessary: Validated operational need
- Correct: Accurate, traceable to capability gaps in analysis
- Unambiguous: Clear, written for layman
- Orderly: Prioritized by user
- Organized: Strategy-to-task, traceable
- Results-Oriented: Capability based, not design specification

In order to insert quality requirements into the CDD/CPD, it is important that requirements writers understand the "look and feel" of attributes and requirements in Section 6. The following text presents the standard format of Section 6 requirements and then provides a full sample requirement in that format to help familiarize requirements writers with the presentation of performance attributes.

Format of a Good Requirement
6.X.X Attribute Title: Name of the performance attribute (KPP/KSA/APA #_____)

Discussion: Explain what the attribute is, why it is included, why it is prioritized as such, and any amplifying information from the High Performance Team (HPT).

Threshold: What is the minimum operational requirement value? This value must be written in operational language and be measurable, testable, feasible, achievable and understandable. Thresholds are expressed as "shall" statements.

Objective: What is the highest operational value, beyond which this attribute would provide no further military utility? Objectives are expressed as "should" statements.

Rationale: Why are the specific Threshold and Objective values operationally significant? Why is this attribute prioritized as a KPP or KSA?

Analytical References: List the analytic documentation (including page and paragraph

numbers, and quotes if practical) that document the operational need for this attribute at these value levels.

Example of a Good Requirement

Note: *This is an example of a well-written, Joint Requirements Oversight Council (JROC)-approved requirement, with proprietary information redacted. All examples in this HSI Requirements Guide will be redacted in a similar manner.*

6.X.X System ABC Increment 2 XX display (KPP #__)

Discussion: Operators of previous increment wear XX displays in battle and while on dismounted patrol behind enemy lines. Current technology and CONOPS indicate that operators of Increment 2 also will wear and use them in similar situations.

Threshold: Operators shall be able to read the XX display during day and night, with no visible signature at night from 10-50m. Device must enable operators to keep head up while reading the data on computer.

Objective: Operators should be able to read the display during day and night, with no visible signature from 10m with the unaided human eye.

Rationale: Operator must be able to read information from the display day/night, with low visible signature to avoid compromise of operator's location at night. At >50m, enemy observation of emitted light is of little concern since NVGs currently emit out to 50m. At <10m from the enemy, CONOPS require operators to suspend use of system.
Operators must be able to keep heads up, since head-down time reduces situational awareness and creates unacceptable distraction and vulnerability.

Analytical References: Increment 2 RFI results on current technological capability (ref. A), pg. X, para. X. NVG operational test results (ref. B.), pg Y, para Y. Operational command CONOPS (ref C.) pg Z. para Z.

6. REQUIREMENTS DOS AND DON'TS

In the following table requirements writers will find additional tips for writing effective requirements.

DOs	DON'Ts
Do determine that a new requirement is needed.	Don't add attributes that are not related to identified capability gaps.
Do make sure the capability gaps are understood before requirements are written.	Don't address capability gaps without ensuring everyone understands the problem and its scope.
Do define the expected user population and environment.	Don't assume the pilot or operator is the only person using the system.
Do make sure requirements are situated in the right place in the system development life cycle.	Don't put an inappropriate level of detail into a specific kind of document.
Do make sure requirements are operationally defined.	Don't insert technical specifications into operational capability documents.
Do make requirements feasible, affordable, and achievable.	Don't ask for "luxury" attributes or values.
Do provide a number or value for the threshold and objective.	Don't forget that all performance attributes must be measurable and testable.
Do provide values from legacy systems for comparisons.	Don't say "as good as or better than the legacy system" without providing a documented value or measurement.
Do operationalize performance decrements or system dysfunction as a result of discomfort. E.g.: Degraded performance because of: pressure points, hot spots, restrictions in movement, chafing, restricted space, restricted circulation, distraction, blisters, forced extra movement, strains (physical, muscle), long term injury, weight distribution, repetitive motion.	Don't use "comfort" as a requirement.
Do provide a specific value that is supported by solid rationale and a metric (i.e., MTBF) that can be measured/tested. Ex.: Reduce below X.	Don't make standards higher than they realistically need to be. Don't invent a complicated way to measure something that nobody else will understand.
Do consider possible DOTMLPF impacts when writing requirements.	Don't assume the legacy equipment and spares will be removed immediately and, therefore, the

DOs	DON'Ts
	facilities they are housed in will be available for the new equipment.
Do write requirements according to achievable technological capabilities.	Don't write requirements according to a projection of an advance in technology that is not realistically achievable or feasible in the time frame.
Do document assumptions made when writing requirements or framing a capability.	Don't bury assumptions in an inconspicuous place; discuss them in the main body of the document.
Do consider the training and all other relevant external issues in the CBA that could impact requirements in the CDD.	Don't forget that new technologies will require educating senior leaders on the capabilities and implementation of this asset.
Do keep it simple.	Don't write compound requirements. Compound requirements are difficult and costly to defend and implement.
Do know when capabilities will need to be fielded.	Don't use optimistic timelines that are politically or financially insupportable.
Do involve all the stakeholders.	Don't write requirements in a vacuum.
Do discuss capabilities (verbs) or programs in development that touch or need to be considered or synchronized along with the program.	Don't include names of industry components, materials, software objects, fields, and records.
Do make requirements quantifiable, repeatable, and verifiable.	Don't assume something can't be tested; consult with AF/TE or AFOTEC community.
Do make requirements testable with available test instrumentation and resources.	Don't neglect to consider unique test costs if they will be required (ex. building bunkers to test a bunker buster bomb).

7. SAMPLE CDD/CPD REQUIREMENTS

This section contains example requirements for CDD/CPD Sections 6, 14, and 15 that are provided as a template for developing the requirements writer's own unique requirements language. When the requirements writer identifies the need for an HSI-related requirement, the contents of this section can assist in crafting the appropriate language for the requirement. The sample requirements for CDD/CPD Section 6, 14 and 15 are taken from recent JROC-approved capabilities documents.

CDD/CPD Section 6 Example Requirements

The first part of this section focuses on Section 6 of the CDD/CPD (System Capabilities Required for the Increment). In Section 6 the mandatory KPPs and associated KSAs are listed. For each KPP, the following pages provide a generic consideration that may be applicable to the capability under design, followed by sample language for addressing that consideration.

Mandatory KPPs/KSAs	Sample Language for CDD/CPD Section 6
1. **Net-Ready KPP:** *Domains: human factors engineering, manpower, personnel, training, occupational health, habitability*	The Net-Ready KPP contains boilerplate language for any system that will interact with the Global Information Grid. This will be a "copy and paste" from a template provided by the AF/A5RP (not included here). *Note: The presence of the Net-Ready KPP suggests that certain HSI considerations may be important for that system. When you encounter the Net-Ready KPP, consider what additional attributes will be required in Section 6 to address the HSI implications for maintenance of the connections, design of any user interfaces and the knowledge, skills and attributes of personnel who will operate and maintain the net-centric systems.*
2. **Survivability KPP:** Consider all signatures that may alert an enemy, to include visible signatures. *Domains: human factors engineering, safety, survivability*	Threshold: When employing proper escape/evasion and camouflage/concealment techniques, the XX will have a visible signature with less than a 10% probability of detection at 328 ft (100m) with the unaided eye, optical magnification, and NV devices.
3. **Survivability KPP:** Consider the survivability of the system under fire from small arms threats. *Domains: human factors engineering, safety, survivability*	The operating altitudes of the XX (platform) will be above all small arms threats and smaller caliber light AAA threats. The modification package (this CDD) shall detect, provide avoidance recommendation, and/or counter all anticipated threats in a low threat environment (e.g., small arms, light AAA, & MANPADS) while maintaining a persistent, tactically responsive presence over the area of operations, day or night. Finally, the modification package will enhance the donor aircraft's survivability with standoff posture through Sensor Capabilities and SOPGM.

Mandatory KPPs/KSAs	Sample Language for CDD/CPD Section 6
4. **Force Protection KPP:** Consider the impacts of thermal stress on the human associated with the system. *Domains: human factors engineering, safety, occupational health, training, survivability*	Threshold: In each configuration, the XX will impose less thermal burden on the aircrew than the flight equipment it replaces. Specifically, the XX will enable non-helicopter fliers to tolerate brief (30 minute) exposures to hot, humid (90°F and 85% relative humidity (RH)) environments, cool rapidly on introduction to a representative cockpit environment (70°F and 40% RH), then continue to minimize thermal burden for the Maximum Typical Daily Sortie Duration (MTDSD) as defined in Appendix F. For helicopter flyers, the XX will enable the aircrew to tolerate the operational temperature range cited in the Center for Army Lessons Learned (CALL) Special Study 05-16d for the full MTDSD. To meet this requirement, the comparative thermal burden measures to be utilized will include both the objective water vapor permeability to thermal resistance ratio (im/clo) of the garment(s), and a subjective scientific aircrew survey. In no case will the aircrew's core body temperature exceed 101°F under the conditions mentioned above. The XX will allow the occupant to tolerate indefinite exposures to the full operational temperature range. If incorporated, active cooling measure(s) will not require aircraft modifications.
5. **Force Protection KPP:** Consider exposure tolerances for acceleration and G forces. *Domains: human factors engineering, safety, occupational health, training, survivability*	Threshold: When used in conjunction with pressure breathing for G (PBG), the XX will provide a mean score of at least 85 seconds in the weighted time and acceleration exposures of a relaxed rapid onset series. This series is defined as follows: rapid onset (+6 G/sec) to +3 Gz and hold for 15 seconds followed by a 2 minute rest. The profile is repeated using incremental increases of +1 Gz up to +9 Gz. The subject remains relaxed (no anti-G straining maneuver) for the entire series. The total possible score is 105 seconds. The test stops when the subject experiences 100% peripheral or 50% central light loss. Objective: When used in conjunction with YY, the XX will allow all wearers to fully complete the weighted time and acceleration exposures of a rapid onset to +9 Gz.

Mandatory KPPs/KSAs	Sample Language for CDD/CPD Section 6
6. **Force Protection KPP:** The ability of the system to provide protection for crew members from potential threats (e.g. ballistic protection). *Domains: human factors engineering, safety, occupational health, training, survivability*	Threshold: On selection by the user, the XX will be field modifiable to provide ballistic protection. This capability will include soft armor, hard armor, or a combination of the two. The user will be able to install a soft armor system, compliant with the US Army Individual Body Armor (IBA) standards for threat resistance and environmental exposure, which provides modular protection to the front, back, and sides of the torso; shoulders, neck, back, upper arms, and groin. If adjoining areas are selected, the armor will provide continuous coverage, without any gaps in the armor. The soft armor will not preclude or restrict any user movement. The user will be able to install a hard armor system, equivalent to the US Army Enhanced Small Arms Protective Insert (ESAPI) standard that provides modular protection to the front, back, and sides of the torso. Aircrew members will be able to release hard armor with one hand, without a significant hazard of inadvertent release. In order to facilitate doffing CB contaminated ensembles, the armor must be removable while the aircrew member is still wearing their respiratory protection. The hard armor will not significantly preclude or restrict user movement. Soft armor will be neutrally buoyant. The hard and soft armor will be configurable by the user based on mission needs. Objective: Hard armor will exceed US Army ESAPI specification and/or be flexible. All armor will be neutrally buoyant.
7. **System Training KPP:** The need to provide training for external personnel who interact with the system. *Domains: manpower, personnel, training*	Threshold: Hands-on training is required for 25 personnel at the centralized weather organizations to operate and maintain XX provided systems. For external users, the contractor is required to develop computer based training modules for all external services. Objective 50 personnel.
8. **Materiel Reliability KSA:** Specify reliability metrics such as Mean Time Between Failure (preferred), or based on a typical mission as in this example. *Domains: manpower, personnel, training*	For all XX variants, the probability of successfully completing a mission of “T” hours should be .98 throughout the lifecycle. “T” equals the mission times as specified in Appendix F. T=O.

Mandatory KPPs/KSAs	Sample Language for CDD/CPD Section 6
9. **Materiel Reliability KSA:** Mean Corrective Maintenance Time (MCMT) can be used as further support to Materiel Reliability. *Domains: manpower, personnel, training*	The maintainer will be able to complete maintenance corrective actions within (T=30, O=10) minutes.
10. **Materiel Reliability KSA:** Mean Preventative Maintenance Time (MPMT) can be used as further support to Materiel Reliability. *Domains: manpower, personnel, training*	The XX will have a MPMT of less than (T=1, O=.5) hours per 6 months to ensure system availability.
11. **Ownership Cost KSA:** Consider costs for operators, maintainers, and other support personnel. Remember to figure in costs for fuel, storage, transportation, demilitarization and disposal. *Domains: manpower, personnel, training, safety, habitability, occupational health, environment*	The Operations and Support (O&S) costs will be within 5% (T)/ 2% (O) of the estimated cost baseline at each IOC. All hardware maintenance and system administration will be performed through Contractor Logistics Support (CLS) throughout the life cycle. Testing and Evaluation will be performed by the XXth Test Squadron.

CDD/CPD Section 14 Example Requirements

Section 14 of the CDD/CPD (Other DOTMLPF and Policy Considerations) provides the opportunity to address a number of HSI domains and considerations not linked directly to KPPs for the given capability. Below are sample requirements that can be used in Section 14 of the CDD/CPD as appropriate to ensure HSI is represented in the CDD/CPD.

Other DOTMLPF Considerations	Sample Language for CDD/CPD Section 14
1. **HSI Plan:** *Domains: all*	A comprehensive HSI plan will be developed and executed within the systems engineering plan for this system. It will include specific attention to integrated treatment of Human Factors Engineering, Training, Force Structure/Personnel, Safety, Survivability, Habitability, Environment, and Occupational/Operational Health. Particular attention will be assigned to crew stations, weapons station, cargo hold, sensor suite, controls, displays, supportability, usability, lessons learned from prior gunship issues/integrations, human error prevention, interoperability, decision support, information fusion, sensor integration, and personal protection. This process will be supported within the Systems Engineering Integrated Product Team (IPT) structure with an established HSI consultant to assist the Program Manager (PM), the Chief Engineer, and the Chief Systems Engineer in risk management and system integration. Identification, evaluation, and acceptance of potential health hazards must be made by an industrial hygienist.
2.**Safety/Occupational Health:** *Domains: safety, occupational health, training, human factors engineering, survivability*	The system must be designed to eliminate or mitigate safety, health or physical risks. Where hazards/risks exist, health and safety equipment and/or procedures must be identified. Health and Safety procedures and engineering design considerations must conform to AF Operational and Safety health standards. Crew task load, fatigue factors, broad range of operating environments, and data assimilation must be considered.
3.**Safety/Occupational Health:** *Domains: safety, occupational health, human factors engineering, survivability*	Identified safety and health risks will be eliminated, minimized, or controlled to acceptable levels within cost, schedule, and performance constraints as identified in MIL-STD 882D[e] and shall be accomplished for the life of the system.
4. **Environment:** *Domains: environment, human factors engineering, safety, occupational health, training, survivability*	The system design shall reduce or eliminate hazardous chemicals or materials, Ozone Depleting Chemicals, energy requirements, and the generation of hazardous wastes during the manufacture, operation, maintenance, and disposal of the system.

Other DOTMLPF Considerations	Sample Language for CDD/CPD Section 14
5. **HFE:** *Domains: all*	All human engineering aspects shall be in compliance with current HF Engineering practices and coordinated by a Human Factors Engineer.
6. **Training:** Where training concepts and responsibilities need to be specified. *Domains: training, manpower, personnel*	Training will be required for the users and maintainers of the system. Maximum use of the "Train the Trainer" concept will be used. Air Education and Training Command (AETC) will establish initial and follow-on training requirements to include instruction on the fit, inspection, maintenance, and use of the system. The vendor will develop and deliver a training package to AETC. Vendors will provide and AETC will ensure the appropriate training units are provided the necessary assets, test equipment, and technical manuals to conduct training. Vendors will provide Service instructors training in order to establish field training expertise.
7. **Training:** Where new Air Force War College, etc courses are not required. *Domains: training, manpower, personnel*	The system will not drive changes in leadership and will not require changes to professional military education courses. However, the system will require changes to technical training courses.
8. **Manpower:** *Domains: manpower, personnel, training*	Any new Manpower to support the system above current USAF and USSOCOM requirements will be vetted through the corporate process (i.e., new requirements must be brought into the Program Objective Memorandum (POM)). Initial manpower estimates are currently in staffing and will be worked in conjunction with other force structure changes.
9. **Personnel:** Where workload and human performance are key considerations. *Domains: personnel, human factors engineering, training, manpower*	Personnel with the appropriate aptitudes, physical/mental abilities will be employed for the system. In addition, human performance shall be optimized by assessing the workload and tasks and ensuring that each crew member can accomplish the mission without experiencing task saturation.
10. **Maintainability:** Where the system requires support to include Built In Test capability. *Domain: manpower*	The system will be capable of conducting fault isolation and fault detection to the Line Replaceable Unit (LRU) level using technical data, support equipment (manual or automated), or Built In Test Equipment (BITE) used singularly or in combination.

Other DOTMLPF Considerations	Sample Language for CDD/CPD Section 14
11. **Maintainability:** Where alignment of maintenance schedules is a key consideration to optimize operational tempo. *Domain: manpower*	The system inspection concept shall be designed to maximize flying operations by aligning scheduled inspections/ maintenance intervals with donor aircraft.
12. **Maintainability:** Where HSI could provide significant positive impact on maintainability. *Domains: manpower, personnel, training, human factors engineering*	The system design shall take advantage of advances in technology to improve total system performance inclusive of the human, hardware, and software. This includes but is not limited to: usability, effectiveness, decision support/aiding, information management/ fusion, component reliability, embracing the concept of "maintenance by exception", and reducing time required to remove, repair, and replace components. Component and system repair capabilities will use the Air Force 2 Level maintenance concept. Embedded diagnostic tests and measurements shall be incorporated to allow real-time assessment of weapon system condition, improve maintenance agility and responsiveness, increase operational availability, usability of all systems and subsystems, and reduce life cycle total ownership costs creating a smaller deployed logistics footprint. The system shall also be of lightweight design as to aid in the overall service weight relationship of the donor aircraft and duration of on station time required to complete a combat mission.
13. **Sustainability:** Where required support equipment (SE) will impact performance. *Domains: human factors engineering, manpower, training*	Common SE must be used to the maximum extent possible. Unique SE must be kept to a minimum. The system must provide access to all aircraft and subsystem areas without need for unique ground equipment. Hand tools should conform to standard/common hand tools already in the inventory. SE requiring external electrical and or hydraulic power must use USAF common equipment. Hoisting any LRU must not require the need for a ground crane. Required SE must be deployable and capable of setup at a deployed location within 8 hours of arrival. The platform should have a self start capability to allow for operations at locations that do not have applicable external power.
14. **Sustainability:** Where munitions are involved. *Domains: human factors engineering, manpower*	The system will adhere to AFPD 21-2[f] Non-nuclear and nuclear munitions (ref.MM), and AFI 21-203[g], Responsibilities of Accountability for Aircraft Munitions, (ref.NN).

CDD/CPD Section 15 Example Requirements

Section 15 of the CDD/CPD (Other System Attributes) is a final opportunity for HSI to influence system design and other human considerations early in the system development life cycle. Below is sample language that may be useful for including HSI in Section 15.

Other DOTMLPF Considerations	Sample Language for CDD/CPD Section 14
1. **HSI Plan:** *Domains: all*	The HSI domains (i.e. manpower, personnel, training, environment, safety, occupational health, human factors, habitability and survivability) will be optimized for total system performance and reduced life-cycle costs as applicable. Human factors considerations have some impact on XX system effectiveness and suitability. There is a graphical user interface (GUI) for users to create and maintain their subscription information to weather products as well as to view the weather database catalog contents. Therefore, training is required and GUIs to access, view and use weather data products will be designed using human factors engineering principles and best commercial practices such that user interfaces will allow timely, accurate and successful navigation and information retrieval, balance human workload, minimize human effort and provide meaningful system alters, feedback and error correction information.
2.**Survivability:** *Domains: survivability, safety, occupational health, training, environment*	Personnel shall be able to utilize the system as required while wearing the Mission Oriented Protection Posture (MOPP) IV ensemble. The system must enable operators to perform tasks while in MOPP IV ensembles and perform mission tasks in an operational environment.
3. **Survivability:** *Domains: survivability, safety, occupational health, training, environment*	The system will retain functionality in all anticipated threat environments to include CB warfare and high altitude electromagnetic pulse (HEMP). The exterior will be capable of being decontaminated to a safe level to permit reuse.
4. **Sustainability:** *Domains: survivability, safety, occupational health, training, environment*	The design of the system will lower the overall DoD life cycle costs and logistical footprint for this class of systems by reducing _________ (e.g. the number of ensemble types, the number of spares required, etc). The life cycle costs include the development of prototype units, experimentation/ demonstration, testing and procurement. The design of the system shall also minimize integration costs associated with fielding of the system.

Other DOTMLPF Considerations	Sample Language for CDD/CPD Section 14
5. **Embedded Instrumentation for Test and Training:** *Domains: training, manpower, human factors engineering*	The system should have internally installed instrumentation interfaces to support testing and training that is interoperable with existing and planned test and training systems. All electronic tactical systems should have an automatic fault code recorder and tracking system to assist maintenance personnel in maintenance and repair work.
6. **Environment:** This attribute is related to how the system is affected by the environment, and/or how the system affects the environment. *Domains: environment, human factors engineering, safety, occupational health*	The system will withstand environmental conditions associated with worldwide use and maintain operational capability equal to or better than the current system. Conditions include: high/ low operational and storage temperature, temperature shock, solar radiation, humidity, fungus, blowing sand and dust, vibration, salt fog, explosive decompression, transit drop, Petroleum, Oil, and Lubricants (POL), and blowing rain.
7. **Environment:** *Domains: environment, human factors engineering, safety, occupational health*	The system will be required to operate in all environmental regions of the globe without perceptible degradation in performance.
8. **Environmental Impact:** *Domains: environment, human factors engineering, safety, occupational health, manpower, personnel, training*	The system will be consistent with National Aerospace Standard (NAS) 411h, or equivalent to evaluate and manage hazardous usage during all life cycle phases and select the least hazardous material consistent with mission performance and economic constraints. The user will have the ability to train, operate, maintain, and dispose of the system in full compliance with applicable US, foreign, and international environmental quality laws, regulations, executive orders, international agreements, and DoD policies. The design, production, operation, maintenance, and disposal of the system will eliminate or minimize to the greatest extent possible, adverse environmental quality impacts, safety, and occupational health hazards, and ESOH risks including hazardous material usage. These requirements are intended to reduce life cycle costs and environmental quality impacts.

Other DOTMLPF Considerations	Sample Language for CDD/CPD Section 14
9. **Natural Environmental Factors:** *Domains: environment, safety, occupational health, survivability, habitability, training*	Although a hardened shelter is not mandatory, the systems supporting XX services will require an Environmental Conditioning Unit (ECU) for the conditioning the airflow for personnel and equipment in the shelter. The ECU will facilitate the addition of CBRN filtering equipment.
10. **ESOH:** *Domain: environment, safety, occupational health, manpower, personnel, training, human factors engineering, survivability*	Identified ESOH risks will be controlled to acceptable levels within cost, schedule, and performance constraints throughout the lifecycle of the system. ESOH residual exposures and risks will be identified, acknowledged by the appropriate authority and controlled by the order of precedence. XXX users shall have the ability to field, train, operate, maintain, and dispose of the system in full compliance with US, foreign, and international environmental laws and regulations. The design, production, operation, maintenance, and disposal of the system shall eliminate or minimize to the greatest extent possible the use of hazardous material and generation of hazardous wastes, and potential for adverse environmental impacts.

8. KEY WORD REFERENCE MATRIX

Armed with an understanding of the characteristics, format and content of a good requirement, the next task for the HSI requirements developer is to insert those requirements in appropriate places in capabilities documents The key word reference matrix, provided here, is intended to support identification of places (in addition to the KPPs and KSAs previously described) where requirements with HSI considerations can be added to a capability document. The key words will assist the writer in finding human-related considerations throughout these documents. When one of the key words is located, consider the requirements that should be inserted to ensure the human implications of the capability aspect being described are accounted for. It is cautioned that the key word reference is not all encompassing, and that the practitioner is encouraged to thoroughly read the entire capability document for human-related considerations.

Key Word Reference Matrix		
Human Systems	HSI	Operational Suitability
	Human	Supportable
	Maintenance	Supportability
	Situational Awareness	Operational Capability
	Operational Effectiveness	
Manpower	Maintainer	Aircrew
	Crew	Operator
	Maintenance Manhours	Troubleshoot
	Crew Systems	Technicians
	User	Shift Work
Personnel	Skills	Knowledge
	Aptitudes	Abilities
	Physical Characteristics	Skill Sets
	Skill level	Air Force Specialty Codes

	Universal Joint Task List	
Training	Full Mission Trainers (FMT)	Field Training Detachments
	On-the-Job Training	Initial Qualification Training
	Unit Training	Training Devices
	Distributed Mission Training	Unit Qualification Training
	Courseware	Embedded Training
Human Factors Engineering	Human Factors	HFE
	Ergonomic(Ergonomically)	Crew Stations
	Warnings, Cautions, and Alarms	Display
	Workload	Mental
	Physical	Human Error
	Human Engineering	User-Friendly
	Symbology	Helmet Mounted Display
	Night Vision Imaging System (NVIS)	Human-in-the-Loop
	Autonomous Operations	Manual Override
	Fatigue	Sensory
	Anthropometrics	
Habitability	Crew Accommodations	Distinguished Visitor Compartment
	Staff Compartment	Lavatories
	Galley	Food Preparation
	Refuse Container	Trash Compactor

	Food Storage	Potable Water
Personal Survivability	Survivability	Protection
	Susceptibility	Survivable
	Threat	Chemical, Biological, Radiological, Nuclear, Explosive (CBRNE)
	Avoidance	Prevent Fratricide
	Identification Friend or Foe	Battle Damage
	Biologically	Chemically
	MOPP	Predictive Ground Collision Avoidance
	Fatigue	Detection
Environment, Safety, and Occupational Health	Environmental	Safety
	Occupational Health	Safe
	Environment	Foreign Object Debris (FOD)
	Ozone Depleting Chemicals	Toxic
	Hazardous Materials (HAZMAT)	Flight Safety
	Ground Safety	Explosives Safety
	Mishaps	Toxins
	Chemicals	Wastes

9. KEY TERMS FOR HSI REQUIREMENTS WRITERS

The Key Terms section includes terms commonly used in requirements that may benefit from explanation or clarification. In the table below the term is listed along with an operational definition, and additional information that will help the requirements writer clearly articulate the goal of the requirement.

Term	Definition	Other Considerations & Associated Concepts
Accessible	Refers to a design that enables body or appropriate appendage to open and ingress, egress, or reach or pass through a confined space in support of a specified task set.	According to MIL-HDBK 1908A[i], an item is considered accessible when it can be operated, manipulated, removed, or replaced by the suitably clothed and equipped user, operator, or maintainer with applicable body dimensions conforming to the anthropometric range and database specified by the procuring activity or if not specified by the procuring activity, with applicable 5th to 95th percentile body dimensions. Applicable body dimensions are those dimensions which are design-critical to the operation, manipulation, removal, or replacement task.
All-weather	Typically used when trying to describe the environmental conditions under which a system must operate without performance degradation. The term is usually intended to ensure that weather conditions (such as rain, fog, heat or cold) do not adversely impact the system or the operator.	Rather than using the term "all-weather conditions" in a requirement, specify the conditions with descriptions such as: 1) Within the operating envelope; 2) All-weather conditions ranging from [specific place and season] to [specific place and season]; 3) All-weather conditions specified in the CONOPS or use cases (which must be available as an appendix to the document).
Cognitively Ergonomic Display/ Control Configuration	Arrangement of components of information and control/input devices to most effectively support all critical task functional sequences and decision processes.	Most relevant in complex, multiple display/control systems. Complementary to Physically Ergonomic Display/Control Configuration. In dynamic process control systems, typically complementary to Situational Awareness goals and design considerations.

Term	Definition	Other Considerations & Associated Concepts
Comfortable	Refers to a desirable quality of a component system design such that it accommodates the human body or parts, across a range of sizes and ensembles, so as not to cause pain or interfere or stress the individual's capacity to perform.	Rather than using the word "comfort" in a requirement, consider describing the impacts of the following specific comfort-related items on overall performance: pressure points, hot spots, restrictions in movement, chafing, restricted space, restricted circulation, distraction, blisters, forced extra movement, strains (physical, muscle), extra tension, long term injury, weight distribution, or repetitive motion injuries.
Commonality	A quality that applies to materiel or systems: a. Possessing like and interchangeable characteristics enabling each to be utilized, or operated and maintained, by personnel trained on the others without additional specialized training; b. Having interchangeable repair parts and/or components; and c. Applying to consumable items interchangeably equivalent without adjustment.	
Compatibility	The ability of systems, equipment, devices and materiel to operate in their intended operational environments without suffering unacceptable degradation or without causing unacceptable performance interactions or responses. It involves the application of sound system, equipment, device and materiel design configurations that ensures interference-free operation, and clear concepts that maximize operational effectiveness.	

Term	Definition	Other Considerations & Associated Concepts
Fatigue	Refers to the consequence (both physical and mental) of sustained performance over time	Consider addressing specific metrics that can be impacted by fatigue such as: error rate, error rate variability (are more errors observed after prolonged performance), missed cues, reduced vigilance (incorrectly categorized signals), reduced maximum strength or reduced sustained strength. In cases where fatigue is specified in a requirement also specify the expected task performance durations so that test and evaluation activities can test performance over the appropriate period of time.
Habitability	Involves characteristics of system living and working conditions such as: • Lighting • Ventilation • Adequate space • Vibration • Noise • Temperature control • Availability of medical care, food and/or drink services • Suitable sleeping quarters • Sanitation and personal hygiene facilities	Habitability considerations include: 1. Sustained/extended operations/performance; 2. Extremes of temperature that personnel may have to function in for a long period of time; 3. Support functions – personal services - associated with a system[j]. Such characteristics are necessary to sustain high levels of personnel morale, motivation, quality of life, safety, health, and comfort, contributing directly to personnel effectiveness and overall system performance. These habitability characteristics also directly impact personnel recruitment and retention. Some operational/organizational issues may preclude sufficient attention to habitability concerns, hence other HSI domains may need to be worked to mitigate the resulting effects on system personnel and performance.

Term	Definition	Other Considerations & Associated Concepts
Interchangeable	The ability of systems, units, or forces to replace like systems, units, or forces that possess common capabilities and like characteristics to fulfill relevant requirements without causing unacceptable performance degradations when exchanged.	
Interoperability	1. The ability to operate in synergy in the execution of assigned tasks[k,l]. 2. The ability of systems, units or forces to provide data, information, materiel, and services to, and accept the same from, other systems, units or forces and use the data, information, materiel and services so exchanged, to enable them to operate effectively together[c].	The degree of interoperability should be defined when referring to specific cases[l].
Intuitive (control)	Intuitive here refers to a control that is typical of controls widely used and/or is consistent in directions, locations or types of force applications in a way that most intended users quickly understand and use as they support the intended task set.	
Intuitive (display)	Intuitive refers to a display that, beyond readability and regardless of modality, presents relationships among critical components of information in a way that most intended users quickly understand as they support the intended task set.	

Term	Definition	Other Considerations & Associated Concepts
Minimize	To reduce to the smallest possible amount or degree	Instead of using "minimize" in a requirement, work to quantify the reduction expected. Use language such as: 1) Reduce to [specific standard as minimum and maximum] 2) Reduce below [specific standard, may be drawn from legacy system but should be stated as a specific standard].
Occupational Health	Promotes system design features and procedures that serve to minimize the risk of injury, acute or chronic illness or disability, and enhance job performance of personnel who operate, maintain, or support the system.	When dealing with occupational health issues in a requirement, consider supporting standards that can help clearly define and constrain the capability such as: • Occupational Safety and Health Administration (OSHA) standards • AF Medical standards • Ergonomic Standards • HAZMAT standards
Physically Ergonomic Display/Control Configuration	Combines anthropometric and biomechanical (including sensory/ perceptual) considerations to generate a physical configuration of displays and controls that optimize task set performance potential.	Most relevant in complex, multiple display/control systems. Complementary to Cognitively Ergonomic Display/ Control Configuration.
Readability	Based on psychophysical data, information presented on the display shall exceed thresholds (by best practice margins) for sensation and perception taking into account all environmental and ensemble conditions anticipated in operational use.	It is important to note that a display that is "readable" does not imply that the information presented is also understandable to the user. Be sure to distinguish between the physical quality of readability and the mental capacity implied by understandable.
Reduce; Below		Provide absolute acceptable value; compare to a value from a legacy system; but any value needs to have a solid rationale and be of a metric that can be measured/tested.

Term	Definition	Other Considerations & Associated Concepts
Situational Awareness	Knowledge and understanding of the current situation which promotes timely, relevant and accurate assessment of friendly, competitive and other operations within the battlespace in order to facilitate decision making. An informational perspective and skill that fosters an ability to determine quickly the context and relevance of events that are unfolding[m].	Has to do with the operator being able/ available to receive and process cues and information. Potential measures/ indicators of Situational Awareness include: • Attention • Error rates • Task management • Threat ID • Workload • Resource conflict
Usability	A term used to denote the ease with which people can employ a system, component, tool, or other human made object in order to achieve a particular goal.	Usability testing is a common process and standard approaches are readily available to the test and evaluation community. Using the term in requirements provides a hook for future test of the capability under design. Evidence of poor usability or training could be reflected by: repetition of task steps, increased error rates, excessive use of on-line help or system documentation and verbal/non-verbal complaints.
User configurable (or tailorable)	Able to make or adapt to suit a special need or purpose.	Use of this term implies that there are parameters that the user can select to set up a display/workstation based on their preference.

Term	Definition	Other Considerations & Associated Concepts
Workload	Refers to perceived and actual performance-based level of effort necessary to perform a task set in relation to a finite capacity or set of capacities. Performance necessarily suffers when capacity is exceeded. Workload includes physical tasks and mental tasks, including decision making, which must be considered to accomplish a mission effectively.	Objective Measures: • Error rate • Time to complete • False positives • Interference with other tasks • Measures of multitasking • Improved Performance Research Integration Tool (IMPRINT) scale [Visual, Auditory, Cognitive, and Psychomotor (VACP)] Subjective measures: • Feelings of overload • NASA Task Load Index (NASA TLX) Physiological measures: • Electrocardiography (EKG) • Infrared (IR) facial flush • Galvanic Skin Response (GSR) • Eye tracking

10. HSI PERSONNEL RESOURCES

The guide provides a listing of Air Force organizations with expertise in Human Systems Integration. In the process of writing requirements documents, please contact the appropriate individuals for assistance should questions about the appropriate language, metrics or references arise. When writing human-centered requirements, always remember there is no one person or organization with a monopoly on information. One or more of the following organizations may be of assistance when documenting human-centered requirements. Phone numbers marked with "HSI Cell Contact" are the main HSI point of contact for the organization.

Organization	Phone	Mission	Website
711th Human Performance Wing	(210) 536-4613	To advance human performance in air, space, and cyberspace through research, education, and consultation, accomplished through synergies created by the wing's three distinct but complementary entities: 1) U. S. Air Force School of Aerospace Medicine 2) Human Effectiveness Directorate 3) Human Performance Integration Directorate.	http://www.wpafb.af.mil/afrl/711HPW/
Aeronautical Systems Center (ASC)		Design, develop and deliver dominant aerospace weapon systems and capabilities for U.S. Air Force, other U.S. military, allied and coalition-partner Airmen, in support of Air Force leadership priorities.	http://www.wpafb.af.mil/asc/index.asp
Air Armament Center (AAC)		Develop, acquire, test, and deploy all air-delivered weapons. AAC applies advanced technology, engineering and programming efficiencies across the entire superior combat capability to the war fighter. The center plans, directs and conducts test and evaluation of U.S. and allied air armament, navigation and guidance systems, and command and control systems and supports the largest single base mobility commitment in the Air Force.	http://www.eglin.af.mil/

Organization	Phone	Mission	Website
Air Combat Command (ACC)	HSI Cell Contact DSN 574-2417 Commercial (757) 674-2417	Serve as the primary force provider of combat airpower to America's warfighting commands. To support global implementation of national security strategy, ACC operates fighter, bomber, reconnaissance, battle management, and electronic combat aircraft. It also provides command, control, communications and intelligence systems, and conducts global information operations. Organize train, equip and maintain combat-ready forces for rapid deployment and employment while ensuring strategic air defense forces are ready to meet the challenges of peacetime air sovereignty and wartime air defense. ACC numbered air forces provide the air component to U.S. Central and Southern Commands with Headquarters ACC serving as the air component to U.S. Northern and Joint Forces Commands. ACC also augments forces to U.S. European, Pacific and Strategic Commands.	http://www.acc.af.mil/
Air Education and Training Command (AETC)	HSI Cell Contact DSN 487-9928 Commercial (210) 652-9928	Air Education and Training Command, with headquarters at Randolph Air Force Base near San Antonio, Texas, was established July 1, 1993, with the realignment of Air Training Command and Air University. AETC's role makes it the first command to touch the life of almost every Air Force member. AETC's mission is to develop America's Airmen today... for tomorrow.	http://www.aetc.af.mil/
AF Flight Test Center (AFFTC)		Conduct and support research, development, test and evaluation of aerospace systems from concept to combat	http://www.edwards.af.mil

Organization	Phone	Mission	Website
AF HSI Office (AFHSIO)	(703) 681-6300	Ensure all AF warfighting systems are designed, built, tested, operated, and sustained in a manner that optimizes total system performance at every warfighter level. Directly supports the Air Force mission to fly, fight and win in air, space, and cyberspace. AFHSIO provides guidance and policy for HSI-related matters.	
Center for Systems Engineering at AFIT (a SAF organization)		Shape the future of systems engineering in the Air Force and DoD to improve our ability to deliver war-fighting capabilities. We will accomplish this by conceptualizing new processes, practices, tools, and resources for the systems engineering workforce through research, education, and consultation.	http://www.afit.edu/cse/
Air Force Operational Test and Evaluation Center (AFOTEC)		Test and evaluate new weapon system capabilities in operationally realistic battlespace environments to provide fact-based, decision-quality data to inform decision makers on a range of accurate, balanced, and timely assessments of effectiveness suitability, and mission capability.	http://www.afotec.af.mil/
AFOTEC Detachment 2, Eglin AFB, FL		Evaluate operational system(s) mission capability, effectiveness, and suitability for Air Force and multiservice users by conducting impartial and realistic operational evaluations and assessments.	http://www.afotec.af.mil/
AFOTEC Detachment 3, Kirtland AFB, NM		Provide Airmen and decision makers timely, relevant, accurate information by evaluating the operational performance and capabilities of Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) weapons systems in the battlespace environment.	http://www.afotec.af.mil/
AFOTEC Detachment 4, Peterson AFB, CO		Operationally test space, missile, and missile defense capabilities in the battlespace environment for the Airman.	http://www.afotec.af.mil/

Organization	Phone	Mission	Website
AFOTEC Detachment 5, Edwards AFB, CA		Ensure Airmen and logisticians have the right tools for the job....Permitting them to effectively and safely accomplish their mission.	http://www.afotec.af.mil/
AFOTEC Detachment 6, Nellis AFB, NV		Plan and conduct realistic, objective, and impartial operational test and evaluation of fighter aircraft.	http://www.afotec.af.mil/
AF Space Command (AFSPC)	HSI Cell Contact Commercial (310) 336-5134	Deliver Space and Missile capabilities to America and its warfighting Commands. AFSPC makes space reliable to United States Airmen (i.e. forces personnel) by assuring their access to space. In addition, AFSPC believes its ICBM forces deter adversaries contemplating the use of weapons of mass destruction (WMD). AFSPC has four primary mission areas: Space forces support involves launching satellites and other high-value payloads into space using a variety of expendable launch vehicles and operating those satellites once in the medium of space. Space control ensures friendly use of space through the conduct of counterspace operations encompassing surveillance, negation, and protection. Force enhancement provides weather, communications, intelligence, missile warning, and navigation. Force enhancement is support to the Airman. Force application involves maintaining and operating a rapid response, land-based ICBM force as the Air Force's only on-alert strategic deterrent.	http://www.afspc.af.mil/

Organization	Phone	Mission	Website
AF Special Operations Command (AFSOC)	HSI Cell Contact DSN 579-1623 Commercial (850) 884-1623	Provide Air Force special operations forces for worldwide deployment and assignment to regional unified commands. Core mission areas are: forward presence and engagement, information operations precision employment and strike, and special operations forces mobility.	http://www2.afsoc.af.mil/
AF Research Laboratory		Lead the discovery, development and integration of affordable warfighting technologies for America's aerospace forces.	http://www.wpafb.af.mil/AFRL/
Air Force Materiel Command (AFMC)		Deliver war-winning expeditionary capabilities to the warfighter through development and transition of technology, professional acquisition management, exacting test and evaluation, and world-class sustainment of all Air Force weapon systems. From cradle-to-grave, AFMC provides the work force and infrastructure necessary to ensure the United States remains the world's most respected Air and Space Force.	http://www.afmc.af.mil/
AF Reserve Command (AFRC)		Supports the Air Force mission to defend the United States through control and exploitation of air and space by supporting Global Engagement. The AFRC plays an integral role in the day-to-day Air Force mission and is not a force held in reserve for possible war or contingency operations.	http://www.afrc.af.mil/

Organization	Phone	Mission	Website
Air Mobility Command (AMC)	HSI Cell Contact DSN 779-6768 Commercial (618) 229-5496	Provides global air mobility. The command also plays a crucial role in providing humanitarian support at home and around the world. AMC Airmen--active duty, Air National Guard, Air Force Reserve and Civil Reserve Air Fleet - provide airlift and aerial refueling for all of America’s armed forces. Many special duty and operational support aircraft and stateside aeromedical evacuation missions are also assigned to AMC. U.S. forces must be able to provide a rapid, tailored response with a capability to intervene against a well-equipped foe, hit hard and terminate quickly. Rapid global mobility lies at the heart of U.S. strategy in this environment—without the capability to project forces, there is no conventional deterrent. As U.S. forces stationed overseas continue to decline, global interests remain, making the unique capabilities only AMC can provide even more in demand. Air Mobility Command also has the mission of establishing bare air bases in contingencies. To accomplish this mission, AMC established two Contingency Response Wings, and operates the Eagle Flag exercise.	http://www.amc.af.mil/
Electronic Systems Center (ESC)		Develop, acquire, modernize, and integrate net-centric command and control, intelligence, surveillance and reconnaissance (C2ISR) capabilities, as well as combat support information systems; provide warfighting commanders with battle field situational awareness and accurate, relevant, decision-quality information on a global information grid.	http://www.hanscom.af.mil/ESC/

Organization	Phone	Mission	Website
Oklahoma City Air Logistics Center (OC-ALC)		Manages a wide range of aircraft engines, missiles and commodity items. The center manages an inventory of aircraft, which include the B-1 Lancer, B-2 Spirit, B-52 Stratofortress, C/KC-135 Stratotanker, E-3 Sentry and contractor logistics support aircraft; as well as a substantial jet engine inventory ranging from the older Pratt and Whitney TF33 to the newer, state-of-the-art engines such as the GE F118. The center performs depot maintenance on all of its aircraft and overhaul and repair on numerous jet engines, as well as being the technology repair center for automatic flight control, engine instruments, air driven accessories, hydraulics/Pneudraulic/pneumatics and oxygen and life support.	http://www.tinker-af.org/
Ogden Air Logistics Center (OO-ALC)		Engineers, sustains and manages logistics and maintenance support responsibilities for some of the Air Force's most sophisticated weapon systems, including the Minuteman intercontinental ballistic missiles. The center is the Air Force Center of Industrial and Technical Excellence (CITE) for low-observable, 'stealth,' aircraft structural composite materials and provides support for the B-2 Spirit multi-role bomber.	http://www.hill.af.mil/library/factsheets/factsheet.asp?id=5594
Space and Missile Command (SMC)		Delivers unrivaled space and missile systems to the joint Warfighter and our nation. We strive to continue to be the recognized center of excellence for military space acquisition, producing innovative, affordable, operationally effective space systems.	http://www.losangeles.af.mil
Warner Robins Air Logistics Center (WR-ALC)		Performs sustainment and depot maintenance on a number of US Air Force weapon systems. Specifically it supports AC-130, C-5 Galaxy, C-17 Globemaster III, C-130 Hercules, E-8 Joint STARS, EC-130, F-15 Eagle, HC-130, HH-60 Pave Hawk, MC-30, MH-53 Pave Low, RQ-4 Global Hawk, U-2 Dragon Lady, and UH-1 Iroquois aircraft.	http://www.robins.af.mil/

11. HSI POLICY AND RESOURCES

This section of the guide provides references and links to Air Force and other Department of Defense policy and guidance documents that discuss Human Systems Integration and direct its application in system acquisition efforts. Additionally, a list of other resources to assist requirements writers is provided including links to courses that provide information on requirements and the requirements development process.

- DoDD 5000.01, The Defense Acquisition System. Defines the program manager (PM) as the responsible party for the implementation of HSI. NSS 03-01, Guidance for DoD Space System Acquisition Process is now an annex to the 5000 series
    - Available from the Defense Acquisition Policy Center at: https://akss.dau.mil/dapc/index.aspx

- DoDI 5000.02, Operation of the Defense Acquisition System. Enclosure 8 defines HSI and mandates that the acquisition program manager have a comprehensive plan for it early in the acquisition process.
    - Available from the Defense Acquisition Policy Center at: https://akss.adu.mil/dapc/index.aspx

- CJCSI 3170.01G, Joint Capabilities Integration and Development System. Establishes the overarching policy for defense acquisition and the capabilities-based planning approach. Important reading for understanding how HSI fits into acquisition.
    - Available from the Defense Acquisition University at: https://acc.dau.mil/CommunityBrowser.aspx?id=267681&lang=en-US

- AFI 10-601, Capabilities-Based Requirements Development. Guides requirements writers on how to write and staff all requirements documents. Also defines HSI and ensures Air Force HSI concerns are addressed in all capabilities-based development documents.
    - Available from the Air Force e-Publishing Website at: http://www.e-publishing.af.mil/shared/media/epubs/AFI10-601.pdf

- AFI 99-103, Capabilities-Based Test and Evaluation. Emphasizes HSI as a consideration within Operation Test and Evaluation (OT&E).
    - Available from the Air Force e-Publishing Website at: http://www.e-publishing.af.mil/shared/media/epubs/AFI99-103.pdf

- MIL-STD-1472F, Department of Defense Design Standard Human Engineering. Addresses practice of and interaction between of Human Engineering, Human Factors, and HSI.

Considered the authoritative source of guidance on Human Engineering effort during the acquisition process.

- Available from the Acquisition Streamlining and Standardization Information System (ASSIST) at: http://assist.daps.dla.mil/quicksearch/basic_profile.cfm?ident_number=201925

Additional Resources for Requirements Writers

Along with the policy and reference documents cited above, there are a number of other resources that may be helpful in the requirements writing process.

- The Defense Acquisition Guidebook (DAG). The purpose of the DAG is to provide members of the acquisition community and industry partners with an interactive, online reference to policy and discretionary best practice. Requirements writers should consider the DAG a valuable resource when designing programs. Chapter 6 of the DAG directly addresses HSI.
  - Available from the Defense Acquisition University at: https://acc.dau.mil/dag

Defense Acquisition University Courses on Requirements

- CLM 041, Capabilities Based Planning. Provides an overview of the guidance and policies from the Department of Defense (DoD) supporting Capabilities Based Planning. The module explains the processes, roles and responsibilities, and challenges involved in transforming a traditionally hardware-centric acquisition system to better address emerging threats to national security.

- RQM 110, Core Concepts for Requirements Management. Allows professionals to study the role of both the requirements manager and requirements management within the "Big A" acquisition construct. It examines the process from an end-to-end perspective, highlighting the intersection between acquisition, resources, and requirements.
  - To apply for either course, a DAU student account can be set up at: https://learn.dau.mil
  - In addition, CLM 041 may be browsed at: http://icatalog.dau.mil/onlinecatalog/courses.aspx?crs_id=396 and RQM 110 may be browsed at: http://icatalog.dau.mil/onlinecatalog/courses.aspx?crs_id=485

Air Force Institute of Technology Courses

- REQ 111, Capability Based Operational Requirements Course. Specifically designed for new MAJCOM, FOA, ALC, and HQ AF action officers, operational test managers, analysts, and contractor support personnel who write or review operation capability documents.
  The objective is to enhance the effectiveness of personnel directly developing the definition, validation, and refinement of operational capabilities.
  - Details and Application point of contact available from the Air Force Institute of Technology website at: http://www.afit.edu/Is/coursedes.cfm?p=30

12. GLOSSARY

Term	Definition
"-ilities"	The operational and support requirements a program must address (e.g., availability, maintainability, vulnerability, reliability, logistics supportability, etc.)[n].
Accessible	Refers to a panel or door design that enables body or appropriate appendage to open and ingress, egress, or reach or pass through a confined space in support of a specified task set. *Refer to Section 9: Key Terms for HSI Requirements Writers.*
Accessibility	A measure of the relative ease of admission to the various areas of an item for the purpose of operation or maintenance[n].
Affordability	A determination that the Life Cycle Cost (LCC) of an acquisition program is in consonance with the long-range investment and force structure plans of the DoD or individual DoD Components[n].
All-Weather	Typically used when trying to describe the environmental conditions under which a system must operate without performance degradation. The term is usually intended to ensure that weather conditions (such as rain, fog, heat, or cold) do not adversely impact the system or the operator. *Refer to Section 9: Key Terms for HSI Requirements Writers.*
Availability	A measure of the degree to which an item is in an operable state and can be committed at the start of a mission when the mission is called for at an unknown (random) point in time. *See Inherent Availability, Achieved Availability, Operational Availability, and Availability Key Performance Parameter*[n].
Capability	The ability to achieve a desired effect under specified standards and conditions through combinations of ways and means to perform a set of tasks. It is defined by an operational user and expressed in broad operational terms in the format of a Joint Capabilities Document or an Initial Capabilities Document (ICD) or a joint Doctrine, Organization, Training, Materiel, Leadership and education, Personnel, and Facilities (DOTMLPF) change recommendation. In the case of materiel proposals, the definition will progressively evolve to DOTMLPF performance attributes identified in the Capability Development Document (CDD) and the Capability Production Document (CPD)[n].
Cognitively Ergonomic Display/ Control Configuration	Arrangement of components of information and control/input devices to most effectively support all critical task functional sequences and decision processes. Most relevant in complex, multiple display/control systems. Complementary to Physically Ergonomic Display/Control Configuration. In dynamic process control systems, typically complementary to Situational Awareness goals and design considerations. *Refer to Section 9: Key Terms for HSI Requirements Writers.*
Comfortable	Refers to a desirable quality of a component system design such that it accommodates the human body or parts, across a range of sizes and ensembles, so as not to cause pain or interfere or stress the individual's capacity to perform. *Refer to Section 9: Key Terms for HSI Requirements Writers.*

Commonality	A quality that applies to materiel or systems: a. Possessing like and interchangeable characteristics enabling each to be utilized, or operated and maintained, by personnel trained on the others without additional specialized training; b. Having interchangeable repair parts and/or components; and c. Applying to consumable items interchangeably equivalent without adjustment[o].
Compatibility	The capability of two or more items or components of equipment or material to exist or function in the same system or environment without mutual interference[n].
Dependability	Ability to fulfill the required performance under given conditions, taking degradation of performance due to failure and maintenance into consideration[j].
Doctrine	Fundamental principles that guide the employment of US military forces in coordinated action toward a common objective. Though neither policy nor strategy, doctrine serves to make US policy and strategy effective in the application of US military power. Doctrine is based on extant capabilities. Doctrine is authoritative guidance and will be followed except when, in the judgment of the commander, exceptional circumstances dictate otherwise[c].
Energy Efficiency KPP	The Energy Efficiency KPP, when applied, requires consideration for fuel efficiency for fleet purchases and operational plans consistent with mission accomplishment.
Environment	Considers water, air, land, space, cyberspace, markets, organizations and the relationships which exist among them and with all living things and systems. Environmental considerations may affect the concept of operations and requirements to protect systems from the environment and to protect the environment from system design, manufacturing, operations, sustainment, and disposal activities[j].
Environmental Quality	The condition of the following elements that make up the environment: flora, fauna, air, water, land, and cultural resources[n].
Extensibility	The ability of the system to be modified – retrofitted easily, for example with wiring for new displays, new weapons, etc. The discipline would involve tradeoffs that would involve standardization and compatibility of interfaces for upgrades, as the system ages and requires new versioning to meet an additional mission requirement. The selection of displays and other interfaces for the human/system would obviously be determined by HSI and must be chosen with the longer term view of extensibility in mind.
Facilities	Includes the permanent, semi-permanent, or temporary real property assets required to operate and support the materiel system, including conducting studies to define types of facilities or facility improvements, locations, space needs, utilities, environmental requirements, real estate requirements, and equipment. One of the traditional elements of Logistics Support (LS)[n].
Fatigue	Refers to the consequences (both physical and mental) of sustained task performance over time. *Refer to Section 9: Key Terms for HSI Requirements Writers.*
Force Protection KPP	The Force Protection KPP, for manned platforms, deals with system attributes similar to those found in the Survivability KPP, but addresses the protection of personnel.

Full Operational Capability (FOC)	In general, attained when all units and/or organizations in the force structure scheduled to receive a system 1) have received it and 2) have the ability to employ and maintain it. The specifics for any particular system FOC are defined in that system's Capability Development Document (CDD) and Capability Production Document (CPD)[n].
Habitability	Involves characteristics of system living and working conditions such as: • Lighting, • Ventilation, • Adequate space, • Vibration, noise, and temperature control, • Availability of medical care, food and/or drink services, • Suitable sleeping quarters, sanitation, and personal hygiene facilities. Such characteristics are necessary to sustain high levels of personnel morale, motivation, quality of life, safety, health, and comfort, contributing directly to personnel effectiveness and overall system performance. These habitability characteristics also directly impact personnel recruitment and retention. Some operational/organizational issues may preclude sufficient attention to habitability concerns, hence other HSI domains may need to be worked to mitigate the resulting effects on system personnel and performance[j].
Human System Integration (HSI)	HSI is the interdisciplinary technical and management processes for integrating human considerations within and across all system elements; an essential enabler to systems engineering practice[j]. *Refer to Section 1: What is HSI*?
Human Factors Engineering (HFE)	Involves understanding and comprehensive integration of human capabilities (cognitive, physical, sensory, and team dynamic) into system design, beginning with conceptualization and continuing through system disposal. The primary concern for HFE is creating effective integration of human-system interfaces to achieve optimal total system performance (use, operation, maintenance, support, and sustainment). This "optimal performance" is the achievement of: • Primary, secondary, backup and emergency tasks and functions • Goals and objectives • Avoidance of errors in all expected environments. HFE, through comprehensive task analyses (including cognitive), helps define system functions and then allocates those functions to meet system requirements. These efforts should recognize the increasing complexity of technology and the associated demands on people. The design should not demand unavailable or unachievable skills. HFE maximizes usability for the targeted range of users/customers; minimizes design characteristics that induce frequent or critical errors; and strives to eliminate the need for workers to design work-arounds. HFE works with the IPDTs to ensure that representative personnel are tested in situations to determine whether the human can operate, maintain, and support the system in adverse environments, while working under the full range of anticipated mission stress and endurance conditions[j].

Industrial Capability	That part of the total privately owned and government owned industrial production and depot level equipment and maintenance capacity in the United States and its territories and possessions, as well as capacity located in Canada, that is, or shall be made available in an emergency, for the manufacture of items required by the U.S. military services and selected allies[n].
Inherent Availability (A_I)	Availability of a system with respect only to operating time and corrective maintenance. A_I ignores standby and delay times associated with preventive maintenance as well as Mean Logistics Delay Time (MLDT) and may be calculated as the ratio of Mean Time Between Failure (MTBF) divided by the sum of MTBF and Mean Time To Repair (MTTR), that is: $A_I = MTBF/(MTBF+MTTR)$[n].
Inherent Reliability and Maintainability (R&M) Value	Any measure of reliability or maintainability that includes only the effects of item design and installation, and assumes an ideal operating and support environment[n].
Initial Operational Capability (IOC)	In general, attained when some units and/or organizations in the force structure scheduled to receive a system 1) have received it and 2) have the ability to employ and maintain it. The specifics for any particular system IOC are defined in that system's Capability Development Document (CDD) and Capability Production Document (CPD)[n].
Interchangeable	The ability of systems, units, or forces to replace like systems, units, or forces that possess common capabilities and like characteristics to fulfill relevant requirements without causing unacceptable performance degradations when exchanged. *Refer to Section 9: Key Terms for HSI Requirements Writers.*
Interchangeability	A condition that exists when two or more items possess such functional and physical characteristics as to be equivalent in performance and durability, are capable of being exchanged one for the other without alteration on the items themselves or of adjoining items, except for adjustment, and without selection for fit and performance[n].
Interoperability	1. The ability to operate in synergy in the execution of assigned tasks[k]. 2. The ability of systems, units or forces to provide data, information, materiel and services to, and accept the same from, other systems, units or forces and use the data, information, materiel and services so exchanged, to enable them to operate effectively together[n]. *Also See: Logistics Interoperability*
Interoperability Watch List (IWL)	Established by the Under Secretary of Defense (Acquisition, Technology and Logistics); Assistant Secretary of Defense (Networks and Information Integration); Chairman, Joint Chiefs of Staff; and Commander, U.S. Joint Forces Command to provide DoD oversight for those Information Technology (IT) and National Security Systems (NSS) activities for which interoperability is deemed critical to mission effectiveness, but for which interoperability issues are not deemed as being adequately addressed. IT and NSS considered for the IWL may be pre-acquisition systems, acquisition programs (any acquisition category), already fielded systems, or combatant commander-unique procurements[n].

Intuitive (control)	Intuitive here refers to a control that is typical of controls widely used and/or is consistent in directions, locations or types of force applications in a way that most intended users quickly understand and use as they support the intended task set. *Refer to Section 9: Key Terms for HSI Requirements Writers.*
Intuitive (display)	Intuitive refers to a display that, beyond readability and regardless of modality, presents relationships among critical components of information in a way that most intended users quickly understand as they support the intended task set. *Refer to Section 9: Key Terms for HSI Requirements Writers.*
Items of Intrinsic Military Utility	End items other than those identified in the "DoD Militarily Critical Technologies List" (MCTL) whose transfer to potential adversaries is controlled for the following reasons: the end product in question could significantly enhance the recipient's military or war-making capability either because of its technology content or because of the quantity to be sold; or, the product could be analyzed to reveal U.S. system characteristics and thereby contribute to the development of countermeasures to equivalent U.S. equipment[n].
Leadership and education	Professional development of the leader is the product of a learning continuum that comprises training, experience, education, and self-improvement. The role of professional military education is to provide the education needed to complement training, experience, and self-improvement to produce the most professionally competent individual possible[c].
Lethality	The probability that a weapon will destroy or neutralize a target[n].
Logistics and Readiness Capabilities	Parameters described in terms of mission requirements considering both wartime and peacetime logistics operations to include measures for mission capable rate, Operational Availability (AO) and frequency, and duration of preventive or scheduled maintenance actions. Also included are combat support requirements such as battle damage repair capability, mobility requirements, expected maintenance levels, and surge and mobilization objectives and capabilities[n].
Logistics Interoperability	A form of interoperability in which the service to be exchanged is assemblies, components, spares, or repair parts. Logistics interoperability will often be achieved by making such assemblies, components, spares, or repair parts interchangeable, but can sometimes be a capability less than interchangeability when a degradation of performance or some limitations are operationally acceptable[n].
Logistics Reliability	The measure of the ability of an item to operate without placing a demand on the Logistics Support (LS) structure for repair or adjustment. Logistics reliability recognizes the effects of occurrences that place a demand on the LS structure without regard to the effect on mission or function[p].
Logistics Supportability	The degree of ease to which system design characteristics and planned logistics resources (including the Logistics Support (LS) elements) allow for the meeting of system availability and wartime usage requirements[n].
Maintainability	The ability of an item to be retained in, or restored to, a specified condition when maintenance is performed by personnel having specified skill levels, using prescribed procedures and resources, at each prescribed level of maintenance and repair. *See Mean Time To Repair (MTTR)*[n].

Manpower	Addresses the number and type of personnel in the various occupational specialties required and potentially available to train, operate, maintain, and support the deployed system. The Manpower community promotes pursuit of engineering designs that optimize the efficient and economic use of manpower, keeping human resource costs at affordable levels. Determination of required Manpower positions must recognize the evolving demands on humans (cognitive, physical, and physiological) and consider the impacts that technology can make on humans integrated into a system. Manpower in HSI is related to but not identical to Human Resources[j].
Materiel	All items (including ships, tanks, self-propelled weapons, aircraft, etc., and related spares, repair parts, and support equipment, but excluding real property, installations, and utilities) necessary to equip, operate, maintain, and support military activities without distinction as to its application for administrative or combat purposes[c].
Materiel Availability	The percentage of the total inventory of a system ready for or performing tasking at a given time[c].
Materiel Availability KPP	AKA Sustainment KPP – includes measures of both Materiel Availability (the percentage of the total inventory of a system ready for or performing tasking at a given time) and Operational Availability (the percentage of time that a system is capable of performing a mission).
Materiel Reliability KSA	Materiel Reliability is a measure of the probability that the system will perform without failure over a specific interval and is generally expressed in terms of a Mean Time Between Failure (MTBF).
Measure of Effectiveness (MOE)	A qualitative or quantitative measure of a system's performance or a characteristic that indicates the degree to which it performs the task or meets a requirement under specified conditions. MOEs should be established to measure the system's capability to produce or accomplish the desired result[n].
Measure of Performance (MOP)	A quantitative measure of a system's capability to accomplish a task. Typically in the area of physical performance (e.g., range, velocity, throughput, payload)[n].
Measure of Suitability (MOS)	A MOS typically relates to readiness or operational availability, and hence reliability, maintainability, and the item's support structure. Several MOSs and/or MOPs may be related to the achievement of a particular MOE[n]. *Also see: Measure of Effectiveness, Operational Suitability, and Measure of Performance.*
Minimize	To reduce to the smallest possible amount or degree. *Refer to Section 9: Key Terms for HSI Requirements Writers.*
Mission Reliability	The probability that a system will perform its required mission-critical functions for the duration of a specified mission under conditions stated in the mission profile[n].
Net-Ready KPP	This is generally a boilerplate paragraph; however the attributes of the system described under this KPP deal with the standards the system will use to make data visible, accessible and understandable to other systems on the Global Information Grid (GIG).
Nuclear, Biological, and Chemical (NBC) Compatibility	The capability of a system to be operated, maintained, and resupplied by persons wearing a full complement of individual protective equipment, in all climates for which the system is designed, and for the period specified in the CDD or CPD[n].

Occupational Health	Promotes system design features and procedures that serve to minimize the risk of injury, acute or chronic illness, disability, and enhance job performance of personnel who operate, maintain, or support the system. The Occupational Health community prompts design features to prevent health hazards where possible, and recommends personal protective equipment, protective enclosures, or mitigation measures where health hazards cannot be avoided. Prevalent issues include: • Noise • Chemical exposures • Atmospheric hazards (e.g. confined space entry and oxygen deficiency) • Vibration • Ionizing and non-ionizing radiation • Human factors considerations that can result in chronic disease or discomfort such as repetitive motion injuries or other ergonomic-related problems[j].
Operability	The ability to keep a system or subsystems in a functioning and operating condition and also work together to accomplish a common task or mission. The argument could be presented that the human plays a large and important role in this specialty as well. A non-optimized design of the human-machine interface will adversely affect this characteristic of the system.
Operational Availability (A_O)	The degree (expressed as a decimal between 0 and 1, or the percentage equivalent) to which one can expect a piece of equipment or weapon system to work properly when it is required, that is, the percent of time the equipment or weapon system is available for use. A_O represents system "uptime" and considers the effect of reliability, maintainability, and mean logistics delay time. A_O may be calculated by dividing Mean Time Between Maintenance by the sum of the Mean Time Between Maintenance, Mean Maintenance Time, and Mean Logistics Delay Time (MLDT), that is: $A_O = MTBM / (MTBM + MMT + MLDT)$. It is the quantitative link between readiness objectives and supportability [n]. *See Mean Time Between Maintenance (MTBM), Mean Maintenance Time (MMT), and Mean Logistics Delay Time (MLDT).*
Operational Capability	The measure of the results of the mission, given the condition of the systems during the mission (dependability)[n].
Operational Effectiveness	Measure of the overall ability to accomplish a mission when used by representative personnel in the environment planned or expected for operational employment of the system considering organization, doctrine, supportability, survivability, vulnerability, and threat[n].
Operational Reliability and Maintainability (R&M) Value	Any measure of R&M that includes the combined effects of item design, quality, installation, environment, operation, maintenance and repair[n].

Operational Suitability	The degree to which a system can be placed and sustained satisfactorily in field use with consideration given to availability, compatibility, transportability, interoperability, reliability, wartime usage rates, maintainability, environmental, safety and occupational health, human factors, habitability, manpower, logistics, supportability, natural environment effects and impacts, documentation, and training requirements[n].
Organization	A unit or element with varied functions enabled by a structure through which individuals cooperate systematically to accomplish a common mission and directly provide or support warfighting capabilities. Subordinate units and elements coordinate with other units and elements and, as a whole, enable the higher-level unit or element to accomplish its mission. This includes the staffing (military, civilian, and contractor support) required to operate, sustain, and reconstitute warfighting capabilities[c].
Ownership Cost KSA	Ownership Cost provides balance to the sustainment solution by ensuring that the operations and support (O&S) costs associated with materiel readiness are considered in making decisions.
Personnel (HSI Domain)	Considers the type of human knowledge, skills, abilities, experience levels, and human aptitudes (i.e. cognitive, physical, and sensory capabilities) required to operate, maintain, and support a system; and the means to provide (recruit and retain) such people. Personnel recruitment, testing, qualification and selection are driven by system requirements. The Personnel community helps define the human performance characteristics of the user population and then determine target populations to select for occupational specialties, manage recruitment, and track retention trends. Personnel must manage occupational specialties to include career progression and assignments. Adequate numbers of workers in these specialties must be recruited, trained, and assigned to meet the entire career field need. Personnel population characteristics can impact manpower and training, as well as drive design requirements. Like Manpower, Personnel is related to Human Resources, but not identical to it[j].
Personnel (in DOTMLPF)	The personnel component ensures that qualified personnel exist to support capabilities. This is accomplished through synchronized efforts of force commanders and Service components to optimize personnel support to the force to ensure success of ongoing peacetime, contingency, and wartime operations[c].
Physically Ergonomic Display/ Control Configuration	Combines anthropometric and biomechanical (including sensory/perceptual) considerations to generate a physical configuration of displays and controls that optimize task set performance potential. Most relevant in complex, multiple display/control systems. Complementary to Cognitively Ergonomic Display/ Control Configuration. *Refer to Section 9: Key Terms for HSI Requirements Writers.*
Probability of Kill (P_K)	The lethality of a weapon system. Generally refers to armaments, (e.g., missiles and ordnance). Usually the statistical probability that the weapon will detonate close enough to the target with enough effectiveness to disable the target[n].

Producibility	The relative ease of manufacturing an item or system. This relative ease is governed by the characteristics and features of a design that enables economical fabrication, assembly, inspection, and testing using available manufacturing techniques[c].
Readability	Based on psychophysical data, information presented on the display shall exceed thresholds (by best practice margins) for sensation and perception taking into account all environmental and ensemble conditions anticipated in operational use. *Refer to Section 9: Key Terms for HSI Requirements Writers.*
Reduce; below	Provide absolute acceptable value; compare to a value from a legacy system; but any value needs to have a solid rationale and be of a metric that can be measured/tested. *Refer to Section 9: Key Terms for HSI Requirements Writers.*
Reliability	The ability of a system and its parts to perform its mission without failure, degradation, or demand on the support system[n]. *Also can be defined as: a function of the relationship between and choice of components can be made to improve or optimize the overall system reliability, maintainability and/or availability. Reliability is expressed generally in terms of Mean Time Between Failure or 1/failure rate. Sometimes defined as the ability of a system and its parts to perform its mission without failure, degradation, or demand on the support system. Also see: Logistics Reliability, Mean Time Between Failure (MTBF) and Mean Time Between Maintenance (MTBM).*
Reliability and Maintainability (R&M) Accounting	That set of mathematical tasks which establish and allocate quantitative R&M requirements, and predict and measure quantitative R&M achievements[n].
Reliability and Maintainability (R&M) Engineering	That set of design, development, and manufacturing tasks by which R&M are achieved[n].
Reliability Availability and Maintainability (RAM)	Requirement imposed on acquisition systems to insure they are operationally ready for use when needed, will successfully perform assigned functions, and can be economically operated and maintained within the scope of logistics concepts and policies. RAM programs are applicable to materiel systems; test measurement and diagnostic equipment, training devices; and facilities developed, produced, maintained, procured, or modified for use. *See individual definitions for Reliability, Availability, and Maintainability[n].*
Reliability Based Logistics (RBL)	Emphasizes the importance of designing reliability into systems and is an expansion of the process used to determine the support concept for a system, subsystem, and/or component. RBL addresses decisions such as consumable versus repairable, commercial versus organic repair, warranties, technology insertion, and Form-Fit-Function Interface (F3I) specifications as methods for facilitating reliable designs[n].

Safety	Promotes system design characteristics and procedures to minimize the potential for accidents or mishaps that: cause death or injury to operators, maintainers, and support personnel; threaten the operation of the system; or cause cascading failures in other systems. Using safety analyses and lessons learned from predecessor systems, the Safety community prompts design features to prevent safety hazards where possible and to manage safety hazards that cannot be avoided. The focus is on designs that have back-up systems, and, where an interface with humans exists, to alert them when problems arise and also help to avoid and recover from errors. Prevalent issues include: • Factors that threaten the safe operation of the system • Walking and working surfaces • Pressure extremes • Control of hazardous energy releases such as: – Mechanical – Electrical – Fluids under pressure – Ionizing or non-ionizing radiation – Fire – Explosions[j]
Serviceability	A measure of the degree to which servicing of an item will be accomplished within a given time under specified conditions[n].
Situational Awareness	Knowledge and understanding of the current situation which promotes timely, relevant and accurate assessment of friendly, competitive and other operations within the battlespace in order to facilitate decision making. An informational perspective and skill that fosters an ability to determine quickly the context and relevance of events that are unfolding[m].
Software Maintainability	The ease with which a software system, or component, can be modified to correct faults, improve performance or other attributes[n].
Software Quality	The ability of software to satisfy its specified requirements[n].
Software Reliability	The probability that software will not cause a failure of a system for a specified time under specified conditions[n].
Supportability	A key component of availability. It includes design, technical support data, and maintenance procedures to facilitate detection, isolation, and timely repair and/or replacement of system anomalies. This includes factors such as diagnostics, prognostics, real time maintenance data collection, and human system integration considerations[n]. *Also see: Logistics Supportability*
Supportability Analysis (SA)	An analytical tool, conducted as part of the Systems Engineering Plan (SEP), to determine how to most cost-effectively support the system over its entire life cycle. It provides the basis for related design requirements that may be included in specifications[n].

Survivability	Addresses characteristics of a system (e.g. life support, body armor, helmets, plating, egress/ejection equipment, air bags, seat belts, electronic shielding, etc.) that reduce susceptibility of the total system to mission degradation or termination; injury or loss of life; and partial or complete loss of the system or any of its components. These issues must be considered in the context of the full spectrum of anticipated operations and operational environments and for all people who will interact with the system (e.g. users/customers, operators, maintainers, or other support personnel). Adequate protection and escape systems must provide for personnel and system survivability when they are threatened with harm[j].
Survivability KPP	The Survivability KPP requires that, for manned systems, the design reduces the likelihood of the system being engaged by hostile fire.
Susceptibility	The degree to which a device, equipment, or weapon system is open to effective attack due to one or more inherent weaknesses. Susceptibility is a function of operational tactics, countermeasures, probability of enemy fielding a threat, etc. Susceptibility is considered a subset of survivability[n].
Sustainability	The ability to maintain the necessary level and duration of operational activity to achieve military objectives. Sustainability is a function of providing for and maintaining those levels of ready forces, materiel, and consumables necessary to support military effort[n].
Sustainment KPP	The Sustainment KPP (aka Materiel Availability KPP) consists of key factors: the Materiel Availability KPP, and the Materiel Reliability and Ownership Cost KSAs. The Materiel Availability KPP includes measures of both Materiel Availability (the percentage of the total inventory of a system ready for or performing tasking at a given time) and Operational Availability (the percentage of time that a system is capable of performing a mission).
System Training KPP	The System Training KPP, when applied, is intended to ensure that projected training requirements and associated costs are appropriately addressed across the program life cycle.
Training (HSI Domain)	Encompasses the instruction and resources required to provide personnel with requisite knowledge, skills, and abilities to properly operate, maintain, and support systems[j].
Training (in DOTMLPF)	Training, including mission rehearsals, of individuals, units, and staffs using doctrine or tactics, techniques, and procedures to prepare forces or staffs to respond to strategic, operational, or tactical requirements considered necessary by the combatant commanders to execute their assigned or anticipated missions[c].
Usability	Refers to the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of user[q].
User configurable (or tailorable)	Able to make or adapt to suit a special need or purpose. *Refer to Section 9: Key Terms for HSI Requirements Writers.*
Utility	The state or quality of being useful militarily or operationally. Designed for or possessing a number of useful or practical purposes rather than a single, specialized one[n].

Vulnerability	The characteristics of a system that cause it to suffer a definite degradation (loss or reduction of capability to perform the designated mission) as a result of having been subjected to a certain (defined) level of effects in an unnatural (man-made) hostile environment. Vulnerability is considered a subset of survivability[n].

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14. ACRONYMS

Acronym	Term
AAA	Anti-aircraft artillery
AAC	Air Armament Center
ACC	Air Combat Command
AETC	Air Education and Training Command
AF	Air Force
AF/TE	Air Force/ Test and Evaluation
AFB	Air Force Base
AFFTC	Air Force Flight Test Center
AFHSIO	Air Force Human Systems Integration Office
AFI	Air Force Instruction
AFIT	Air Force Institute of Technology
AFMC	Air Force Materiel Command
AFOTEC	Air Force Operational Test and Evaluation Center
AFPD	Air Force Policy Directive
AFRC	Air Force Reserve Command
AFRL	Air Force Research Laboratory
AFSC	Air Force Specialty Code
AFSOC	Air Force Special Operations Command
AFSPC	Air Force Space Command
A_I	Inherent Availability
ALC	Air Logistics Center
AMC	Air Mobility Command
A_O	Operational Availability
AoA	Analysis of Alternatives
APA	Additional Performance Attribute
ASC	Aeronautical Systems Center
ASSIST	Acquisition Streamlining and Standardization Information System
ASVAB	Armed Services Vocational Aptitude Battery
BITE	Built In Test Equipment
C2ISR	Command and Control, Information, Surveillance and Reconnaissance
C4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance
CALL	Center for Army Lessons Learned
CB	Chemical and Biological
CBA	Capabilities Based Assessment
CBRN	Chemical, Biological, Radiological, and Nuclear
CBRNE	Chemical, Biological, Radiological, Nuclear, Explosive
CDD	Capability Development Document
CITE	Center of Industrial and Technical Excellence
CLM	Continuous Learning Module
CLS	Contractor Logistics Support
CJCSI	Chairman of the Joint Chiefs of Staff Instruction

Acronym	Term
CJCSM	Chairman of the Joint Chiefs of Staff Manual
CONOPS	Concept of Operations
COTS	Commercial Off The Shelf
CPD	Capability Production Document
DAG	Defense Acquisition Guidebook
DAU	Defense Acquisition University
DCR	DOTMLPF Change Request
DoD	Department of Defense
DoDD	Department of Defense Directive
DoDI	Department of Defense Instruction
DOTMLPF	Doctrine, Organization, Training, Materiel, Leadership and education, Personnel, Facilities
DSN	Defense Switched Network
E3	Electromagnetic Environmental Effects
EA	Evolutionary Acquisition
EA	Electronic Attack
ECU	Environmental Conditioning Unit
EKG	Electrocardiogram
EPA	Environmental Protection Agency
ESAPI	Enhanced Small Arms Protective Insert
ESC	Electronic Systems Center
ESOH	Environment, Safety, and Occupational Health
F3I	Form-Fit-Function Interface
FM	Field Manual
FMT	Full Mission Trainers
FOA	Field Operating Agencies
FOC	Full Operational Capability
FOD	Foreign Object Debris
FOT&E	Final Operational Test and Evaluation
G	Gravity/Gravitational
GIG	Global Information Grid
GOTS	Government Off The Shelf
GSR	Galvanic Skin Response
GUI	Graphical User Interface
Gz	G forces experienced by the human in the vertical (z) axis, i.e. head-to-toe.
HAZMAT	Hazardous Material
HEMP	High-altitude Electromagnetic Pulse
HF	Human Factors
HFE	Human Factors Engineering
HPT	High Performance Team
HSI	Human Systems Integration
IA	Information Assurance
IBA	Individual Body Armor

Acronym	Term
ICBM	Intercontinental Ballistic Missile
ICD	Initial Capabilities Document
ID	Identification
ID	Incremental Development
IFF	Identify Friend/Foe
IMPRINT	Improved Performance Research Integration Tool
INCOSE	International Council on Systems Engineering
IOC	Initial Operating Capability
IOT&E	Initial Operational Test and Evaluation
IPDT	Integrated Product Development Testing
IPT	Integrated Product Team
IR	Infrared
ISO	International Organization for Standardization
IT	Information Technology
IWL	Interoperability Watch List
JCIDS	Joint Capabilities Integration and Development System
JMEM	Joint Munitions Effects Manual
JP	Joint Publication
JROC	Joint Requirements Oversight Council
JUON	Joint Urgent Operational Need
KPP	Key Performance Parameter
KSA	Key System Attribute
LCC	Life Cycle Cost
LRU	Line Replaceable Unit
LS	Logistics Support
MAGTF	Marine Air-Ground Task Force
MAJCOM	Major Commands
MANPADS	Man-Portable Air-Defense Systems
MCMT	Mean Corrective Maintenance Time
MCRP	Marine Corps Reference Publication
MCTL	Militarily Critical Technologies List
MDD	Materiel Development Decision
MIL-HDBK	Military Handbook
MLDT	Mean Logistics Delay Time
MIL-STD	Military Standard
MMT	Mean Maintenance Time
MOE	Measure of Effectiveness
MOP	Measure of Performance
MOPP	Mission Oriented Protective Posture
MOS	Measure of Suitability
MPMT	Mean Preventative Maintenance Time
MTBF	Mean Time Between Failure
MTBM	Mean Time Between Maintenance
MTDSD	Maximum Typical Daily Sortie Duration

Acronym	Term
MTTR	Mean Time to Repair
MW	Microwave
NAS	National Aerospace Standard
NASA TLX	NASA-Task Load Index
NBC	Nuclear, Biological, and Chemical
NFPA	National Fire Protection Association
N-R KPP	Net-Ready Key Performance Parameter
NSS	National Security Systems
NV	Night Vision
NVG	Night Vision Goggles
NVIS	Night Vision Imaging System
O	Objective
O&S	Operations and Support
OC-ALC	Oklahoma City Air Logistics Center
OO-ALC	Ogden Air Logistics Center
OSHA	Occupational Safety and Health Administration
OSS&E	Operational Safety, Suitability, and Effectiveness
OT&E	Operational Test and Evaluation
OTSG	Office of the Surgeon General
PBG	Pressure Breathing for G
PM	Program Manager
POL	Petroleum, Oil, and Lubricants
POM	Program Objective Memorandum
PPB&E	Planning, Programming, Budgeting, and Execution
RAM	Reliability, Availability, and Maintainability
RBL	Reliability Based Logistics
REQ	Requirements
RF	Radio Frequency
RFI	Request for Information
RH	Relative Humidity
R&M	Reliability and Maintenance
SA	Supportability Analysis
SAF	Secretary of the Air Force
SDD	System Development and Demonstration
SE	Support Equipment
SE	Systems Engineer / Systems Engineering
SEP	Systems Engineering Plan
SMC	Space and Missile Command
SOPGM	Stand Off Precision Guided Munitions
T	Threshold
TOC	Total Ownership Cost
USAF	United States Air Force
USSOCOM	United States Special Operations Command
VACP	Visual, Auditory, Cognitive, and Psychomotor

Acronym	Term
WARM	Wartime Reserve Mode
WMD	Weapon of Mass Destruction
WR-ALC	Warner Robins Air Logistics Center

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  - SAF/AQE
  - SAF/AQR
  - SAF/AQX
- Air Combat Command (ACC)
  - A8M
  - A8SR
  - A8X
- Air Education and Training Command (AETC)
  - 58 SOW/SEF
- Air Force Materiel Command (AFMC)
  - A2/5
  - ASC/ENFC
  - 670 AESS/SYMA
  - 711 HPW/HP
  - 773 TS/ENFH
- Air Force Operational Test and Evaluation Center (AFOTEC)
  - A3F
  - A9D
- Air Force Special Operations Command (AFSOC)
  - A5KB
  - SGPP
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